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SOME TRILETE SPORES FROM UPPER MESOZOIC DEPOSITS IN THE EASTERN AUSTRALIAN REGION

By Isabel C. Cookson* and Mary E. Dettmann*

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Abstract

Twenty-nine trilete microspore species are recorded; twenty-one of these are new types. New occurrences for four megaspores species are noted.

Evidence indicating a Lower Cretaceous (Albian) age for several Victorian deposits, three of which have previously been referred to the Lower Jurassic, is brought forward.

A correlation is established between the lower section of the Robe Bore and the Wonthaggi Coal Measures. It is suggested that the age of both deposits is Lower Cretaceous (Neocomian-Aptian).

Introduction

This paper is the outcome of early work on a long-term project which has for its ultimate aim the dating of the freshwater Mesozoic deposits of south-eastern Australia and Tasmania by palynological means. It is concerned partly with the identification and description of some of the more distinctive types of trilete microspores that occur in certain eastern Australian Upper Mesozoic sediments and partly with the stratigraphical implications to which they have given rise.

Until comparatively recently a Jurassic age has been accepted for all the freshwater Mesozoic deposits occurring in Victoria (the Triassic beds of the Bacchus Marsh area excepted) and the adjoining area of south-eastern South Australia. This age determination was originally based on the macroscopic plant remains which are frequently abundant in such Victorian deposits. In 1904, Seward compared the flora of the coal measures of these deposits with that of the Rajmahal Hills in India, while Medwell (1954a) after a re-examination of the flora as a whole came to the conclusion that it was of Lower Jurassic age.

The first intimation of the occurrence of Cretaceous deposits in Victoria was made by Kenley (1954) following the discovery of fragmentary dicotyledonous leaf-remains in the mudstone of the Runnymede Formation in south-western Victoria. The flora of this Formation was assigned to the Lower Cretaceous by Medwell (1954b.).

Concurrently, on palynological grounds, Cookson (1953, 1954) suggested a probable Cretaceous age for the lower section of the Birregurra Bore, 1,073-90 ft., and the sediments in the Comaum Bore, 651-708 ft., and soon afterwards Baker and Cookson (1955) recognized Upper Cretaceous sediments in the Nelson Bore of south-western Victoria, 5,782-6,192 ft.

On the evidence of megaspores, Cookson and Dettmann (1958) have suggested a Lower Cretaceous (Albian) rather than a Jurassic age for certain additional deposits in Victoria and South Australia. Some of the megaspores are referable to species which occur in Lower Cretaceous deposits in the Netherlands and England, others permit correlations with Australian deposits known, by their microplankton content, to be Lower Cretaceous.

* Botany Department, University of Melbourne.

The individual microspore types and microspore assemblages to be considered below give added support to the Lower Cretaceous age-determinations previously mentioned, and clearly indicate a more extensive distribution of Cretaceous sediments in Victoria than was previously recognized.

Furthermore, they suggest that for the Victorian black coal measures, mentioned above, and beds of similar stratigraphic position, a Lower Cretaceous (Neocomian-Aptian) age.

Consideration has been restricted to trilete forms and the system of nomenclature suggested by Potonié (1956) for form-genera of such types has been followed throughout.

Unless otherwise specified, the polar dimensions included in the descriptions have been derived from at least ten examples.

FIG. 1.—Map of south-eastern Australia, showing location of deposits in which the Upper Mesozoic spore associations have been found. (Prepared by the Geological Survey of Victoria.)

Location and Age of Sediments

Western Australia. Carnarvon Basin, Exmouth Gulf area, Gearle Siltstone (lower part). West Australian Petroleum Pty. Ltd., Rough Range Well No. 1 at 2,750 ft. Age: Lower Cretaceous (Albian Cookson and Eisenack 1958. Perth Basin, Moora Bore 86-170 ft. Age: Lower Cretaceous (Albian) Cookson and Eisenack 1958. Canning Basin, Broome No. 1 Artesian Bore at 977 ft. Age: Upper Jurassic Cookson (unpublished).

South Australia. Near Robe, northern portion of section 714, Hundred of Waterhouse. South Australian Oil Wells (No Liability), Bore No. 1, (a) 1,400-2,630 ft. Age: Lower Cretaceous (Albian) Cookson and Dettmann 1958. (b) 2,630-3,500 ft. Age: Jurassic (Ward 1917), Lower Cretaceous (Albian) authors. (c) 3,860-4,300 ft. Age: Jurassic (Ward 1917), Lower Cretaceous (Neocomian-Aptian) authors. Cootabarlow near Lake Frome, Bore No. 2 (a) at 581 ft. and 810 ft. Age: Lower Cretaceous (Albian) Cookson and Eisenack 1958. (b) at 1,354 ft. Age: Lower Cretaceous (Aptian) Cookson and Eisenack 1958. (c) at 1,465 ft. Age: Lower Cretaceous (Neocomian-Aptian) authors. Kopperamanna near Lake Frome, Bore No. 1 at 2,970 ft. Age: Lower Cretaceous (Neocomian-Aptian) Woodard 1955. Tilcha Bore near Lake Frome, at 460 ft. and 1,040 ft. Age: Lower Cretaceous (Albian) Cookson and Dettmann 1958. Loxton near Renmark, Australian Oil and Gas Corporation Ltd., Bore No. 1, at 1,410 ft. and 1,470 ft. Age: Lower Cretaceous (Albian) N. H. Ludbrook, South Australian Department of Mines Palaeontological Report—14/56, 1956 unpublished. Comaum, Hundred of Comaum, Bore No. 1, at 651 ft. and 708 ft. Age: Lower Cretaceous (possibly Albian) Cookson and Dettmann 1958.

Victoria. Nelson, Parish of Glenelg. Carbonaceous sediments from Victorian Department of Mines Bore at 4,782 ft., 6,233 ft., and 6,485-7 ft. Age: Upper Cretaceous Baker and Cookson 1955. Parish of Dergholm. Victorian Department of Mines Dergholm Bore No. 1 at 532 ft. and 582 ft. Age: Lower Cretaceous authors. Dergholm Bore No. 2 329-31 ft. Age: Lower Cretaceous (possibly Albian) Cookson and Dettmann 1958. Barongarook Creek, SW. of Colac. Age: Lower Cretaceous (Albian) Cookson and Dettmann 1958. Birregurra, Parish of Birregurra, carbonaceous sediments from Victorian Department of Mines Bore 1,070-80 ft., 1089-90 ft., and 1,101-2 ft. Age: Lower Cretaceous Cookson 1954. SE. of mouth of Gellibrand River, E. side of Devil's Kitchen, mudstone from near Mesozoic-Paleocene unconformity. Age: Lower Cretaceous (Albian) authors. Apollo Bay, shale containing *Cladophlebis denticulata*. Age: Lower Jurassic Medwell 1954, Lower Cretaceous (Neocomian-Aptian) authors. Bellarine Peninsula, near Geelong, Little's Shaft No. 2 38-47 ft. Age: Lower Cretaceous (Albian) Cookson and Dettmann 1958. Barrabool Hills, 1 m. SW. Fyansford, Geelong. Sample from outcrop along Barwon River. Age: Lower Jurassic Medwell 1954, Lower Cretaceous (?Albian) authors. San Remo Peninsula. Shale conatining *Taeniopteris hislopi* taken from above Coal Measures. Age: Lower Jurassic Medwell 1954, Lower Cretaceous (Neocomian-Aptian) authors. Cape Paterson, W. of Inverloch. Shore platform outcrop. Age: Lower Jurassic Medwell 1954, Lower Cretaceous (Neocomian-Aptian) authors. Whitelaw Railway Station, South Gippsland. Shale containing *Brachyphyllum gippslandicum* (N.M.V. P12805). Age: Lower Jurassic Medwell 1954, Lower Cretaceous (Neocomian-Aptian) authors. Wonthaggi State Coal Mine Area. (a) Victorian Department of Mines Bore No. 175 at 760 ft. Shale containing *Equisetites wonthaggiensis* (N.M.V. P12893). (b) Shale containing *Coniopteris hymenophylloides*. (c) West Area Mine. (1) Carbonaceous seam, west dip section, 400 ft., below sea level. (2)

Carbonaceous mudstone immediately above bottom seam. (3) Mudstone cuttings from floor of bottom coal seam. (d) No. 20 shaft. Carbonaceous mudstone from above top coal seam. (e) Kirrak Area. (1) Main coal seam, 103 ft. below sea level. (2) Mudstone from floor of coal seam. Age: Lower Jurassic Medwell 1954, Lower Cretaceous (Neocomian-Aptian) authors. Korumburra, Sunbeam Collieries. (a) Coal taken from seam at 350 ft. (b) Shale above coal seam. Age: Lower Jurassic Medwell 1954, Lower Cretaceous (Neocomian-Aptian) authors. Alberton, Parish of Alberton West. Victorian Department of Mines Bore No. 137, 174-8 ft., and Bore No. 159, 250-65 ft. Age: Jurassic Victorian Department of Mines Boring Records, 1951-2, published 1955, Lower Cretaceous (?Albian) authors. Berry Creek, Parish of Mardan, Victorian Department of Mines Bore No. 7, samples 10, 17, 18, 19, 65 and 68, and Bore No. 18 at 278 ft. Age: Lower Cretaceous (Neocomian-Aptian) authors. Tyers River, Latrobe Valley, Victorian Department of Mines Bore No. 2 850-1,200 ft. Age: Lower Cretaceous (Neocomian-Aptian) authors. Woodside, near Lakes Entrance. Woodside Well No. 2 sunk by Woodside (Lakes Entrance) Oil Company (No Liability), 4,114-27 ft., 4,251-7 ft., and at 6,402 ft. Age: Lower Cretaceous (Albian) authors. Hedley, near Lakes Entrance. Hedley Well No. 1 sunk by Woodside (Lakes Entrance) Oil Company (No Liability) at 1,460 ft., 2,099 ft., and 2,132 ft. Age: Lower Cretaceous (Albian) authors.

New South Wales. Onepah Station near Tibooburra. Soft fine-grained sandstone dug from a well at an unspecified depth. Age: Lower Cretaceous (Albian) Cookson and Eisenack 1958.

Queensland. Styx Coal Measures. Carbonaceous shales from Queensland Geological Survey's Bore No. 21, at 327 ft., and Bore No. 20, at 454 ft., sunk in the Tooloombah Creek area. Age: Lower Cretaceous (Albian) Walkom 1919, Cookson and Dettmann 1958. Near Weipa Mission, Albatross Bay, Gulf of Carpentaria. Zinc Corporation's Weipa No. 1 Bore, 2,022-41 ft. Age: Aptian authors.

New Guinea. Omati, Papua, Island Exploration Co.'s Bore, Samples 1 and 2. Age: Lower Cretaceous (Albian) Cookson and Eisenack 1958.

Systematic Descriptions

Turma Triletes Reinsch (1881) emend Potonié and Kremp 1954

Subturma Azonotriletes Luber 1935

Infraturma Laevigati Bennie and Kidston 1886

Genus **Divisisporites** Thomson 1952

Divisisporites euskirchenensis Thomson

(Pl. XIV, fig. 1)

Occurrence. South Australia—Robe Bore, at 1,400 ft.; Tilcha Bore, at 460 ft. Victoria—Birregurra Bore No. 1, at 1,102 ft.; Woodside Well No. 2, at 4,251 ft.

Geological Range in Australia. Lower Cretaceous (probable Albian).

Comments. This species was described by Thomson in Thomson and Pflug (1952) from Middle European Tertiary deposits (Paleocene) and subsequently recorded by Delcourt and Sprumont (1955) from the Wealden of Hainaut. The occurrence of *Divisisporites euskirchenensis* in Australian Lower Cretaceous sediments is therefore of interest.

D. euskirchenensis strongly resembles the Lower Cretaceous species *Cingulatisporites euskirchensoides* described by Delcourt and Sprumont (1955) from the

Wealden of Belgium and recorded later in this paper from Australia. It agrees with this form in size, and the subdivision of the tetrad scar only differing from it in the absence of a cingulum. In fact when, as often happens, the cingulum of *C. cuskirchensoides* is imperfectly developed, it is difficult to decide which species is represented.

The above record of *D. cuskirchenensis* is made therefore with some reservation, especially as the examples referred to it have been found only in deposits in which *C. cuskirchensoides* is also present.

Infraturma Apiculati (Bennie and Kidston 1886)

Genus **Granulatisporites** (Ibrahim 1933)

Granulatisporites dailyi sp. nov.

(Pl. XIV, figs. 2-4; holotype, figs. 2, 3)

Occurrence. South Australia—Robe Bore, at 3,860 ft. and 4,300 ft.; Victoria—Barrabool Hills; Wonthaggi State Coal Mine Area, localities (a), (b), (c^3), (e^2); Korumburra shale above coal; Cape Paterson; Berry Creek Bore No. 7, samples 18, 65 and 68, Bore No. 18 at 278 ft.

Description. Spore trilete, tetrahedral (usually considerably flattened), broadly triangular to subcircular in polar view; tetrad-scar slightly raised, laesurae extending to the margin. Exine 2-4·5μ thick, the general surface finely granular, the proximal surface with three clusters of more clearly defined small granules situated at about the middle of the contact faces, the distal surface with a variable number of relatively large thickened areas of unequal size and shape.

Dimensions. Equatorial diameter 34-60μ.

Comments. Although *Granulatisporites dailyi* seems typical of the Lower Cretaceous (Neocomian-Aptian) deposits examined, it has been observed in the ? Albian deposit in the Barrabool Hills.

The specific name is given in honour of Mr. B. Daily, Paleontologist, South Australian Museum.

Genus **Leptolepidites** Couper 1953

Leptolepidites verrucatus Couper

(Pl. XIV, figs. 5, 6)

Occurrence. South Australia—Robe Bore, 3,325-4,300 ft.; Comaum Bore, at 708 ft.; Loxton Bore, at 1,410 ft. and 1,460 ft.; Cootabarlow Bore No. 2, at 1,354 ft. and 1,465 ft.; Kopperamanna Bore, at 2,970 ft. Victoria—Nelson Bore, at 6,485 ft.; Dergholm Bore No. 1, at 582 ft.; Bore No. 2, at 329 ft.; Birregurra Bore No. 1, at 1,102 ft.; Apollo Bay; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Barrabool Hills; San Remo; Cape Paterson shale; Korumburra, shale above coal; Wonthaggi State Coal Mine Area, localities (b), (c^2), (c^3), (d), (e^2); Woodside Well No. 2, at 4,251 ft. and 6,402 ft. Queensland—Styx Coal Measures, Bore 21, at 327 ft. Papua—Omati Bore, samples 1 and 2 (Cookson and Eisenack 1958).

Comments. The relatively small (equatorial diameter 34-43μ) trilete, verrucate spores here referred to *Leptolepidites verrucatus* agree exactly with the description of this species as given by Couper (1953).

L. verrucatus is widely distributed in the eastern Australian region, but is most abundant in the Upper Mesozoic sediments of eastern Victoria. It ranges from Lower Cretaceous (Neocomian-Aptian) to Upper Cretaceous (Nelson Bore).

In New Zealand, *L. verrucatus* appears to be a rare type and to be restricted to the Jurassic.

Genus **Apiculatisporis** Potonié and Kremp 1956

Apiculatisporis wonthaggiensis sp. nov.

(Pl. XIV, figs. 7-10; holotype, fig. 8)

Occurrence. South Australia—Robe Bore, at 3,860 ft. Victoria—Apollo Bay; Wonthaggi State Coal Mine Area, localities (c^3), (e^2); Korumburra, shale above coal; Whitelaw Railway Station.

Description. Spore trilete, biconvex (usually much flattened) subcircular to subtriangular in polar view; tetrad-scar sometimes inconspicuous, laesurae extending to the margin. Exine *c.* 2-3μ thick, unevenly covered with small conical spinules which tend to be more widely spaced in the equatorial region.

Dimensions. Equatorial diameter 40-60μ.

Comments. Apiculatisporis wonthaggiensis seems to have a restricted distribution and to be confined to deposits of Lower Cretaceous (Neocomian-Aptian) age.

Apiculatisporis asymmetricus sp. nov.

(Pl. XIV, figs. 11, 12; holotype, fig. 11)

Occurrence. South Australia—Tilcha Bore No. 1, at 460 ft.; Robe Bore, at 1,400 ft. Victoria—Dergholm Bore No. 1, at 532 ft.; Birregurra Bore No. 1, at 1,102 ft. and 1,089 ft.; Gellibrand River (Devil's Kitchen); Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Woodside Well No. 2, at 4,251 ft. and 6,402 ft.; Hedley Well No. 1, at 2,099 ft. and 2,132 ft.; Papua—Omati Bore, sample 2 (Cookson and Eisenack 1958).

Description. Spore trilete, flattened; amb asymmetrical, subquadrangular to subtriangular with straight to slightly convex sides; tetrad-scar inconspicuous, laesurae extending almost to the margin. Exine about 2μ thick, densely covered with short broadly based spinules.

Dimensions. Equatorial diameter 36-52μ.

Comments. Apiculatisporis asymmetricus can be distinguished from *A. wonthaggiensis* by its asymmetrical and rather straight-sided amb and the denser arrangement and broader bases of the spinules.

Some of the deposits in which *A. asymmetricus* occurs are known to be of Albian age while the age of others is less certain. However, correlation between the microfloras of the dated and undated deposits suggests that all are of approximately Albian age.

Genus **Osmundacidites** Couper 1953

Osmundacidites comaumensis (Cookson)

(Pl. XIV, fig. 13)

Trilites comaumensis Cookson 1953. *Aust. J. Bot.* 1: 470 (Pl. II, figs. 27, 28).
Baculatisporites comaumensis (Cookson) Potonié 1956. *Geol. Jahrb.* 23: 33.
Osmundacidites comaumensis (Cookson) Balme 1957. *C.S.I.R.O. Coal. Res. Sect.* T.C. 25 (Pl. IV, figs. 54-6).

Occurrence. South Australia—Comaum Bore, at 708 ft.; Cootabarlow Bore No. 2, at 1,354 ft., 1,465 ft.; Tilcha Bore No. 1, at 1,040 ft.; Kopperamanna Bore, at 2,970 ft.; Loxton Bore, at 1,410 ft.; Robe Bore, 1,780-4,300 ft.; Comaum Bore, 651-708 ft. Victoria—Nelson Bore, at 5,782 ft., 6,233 ft., and 6,485-7 ft.; Dergholm Bore No. 1, at 582 ft., Bore No. 2, at 329 ft.; Apollo Bay; Birregurra Bore No. 1, 1079-102 ft.; Barongarook Creek; Barrabool Hills; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; San Remo; Wonthaggi State Coal Mine Area, localities (a), (b), (c), (d), (e); Korumburra shale above coal; Cape Paterson, Tyers Bore No. 2, 860-1,200 ft.; Berry Creek Bore No. 7, samples 17, 18, 19, 65, 68, and

Bore No. 18, at 278 ft.; Whitelaw Railway Station; Alberton West Bore No. 137, at 174 ft.; Woodside Well No. 2, at 4,251 ft. and 6,402 ft. Queensland—Styx Coal Measures Bore No. 20, at 454 ft., Bore No. 21, at 327 ft.

Comments. When *Osmundacidites comaumensis* was first described a holotype was not designated. The syntype shown in Pl. II, fig. 28 of Cookson's paper (1953) is herewith distinguished as the holotype and refigured in Pl. XIV, fig. 13.

O. comaumensis is a common and readily recognizable species which during the present investigation has ranged from Lower Cretaceous (Neocomian-Aptian) to Upper Cretaceous. It has been identified by Balme (1957) in Upper Jurassic and Cretaceous deposits in Western Australia and a closely similar form has been isolated from Quaternary deposits near Melbourne, Duigan and Cookson (1957).

Genus **Neoraistrickia** Potonié 1956

Neoraistrickia truncatus (Cookson)

(Pl. XIV, figs. 14-16; holotype, fig. 14)

Trilites truncatus Cookson 1953. *Aust. J. Bot.* 1: 471 (Pl. II, fig. 36).
Neoraistrickia truncatus (Cookson) Potonié 1956. *Geol. Jahrb.* 23: 34.

Occurrence. South Australia—Robe Bore, 3,325-4,300 ft.; Cootabarlow Bore No. 2, at 1,354 ft. and 1,465 ft.; Comaum Bore, 651-708 ft.; Kopperamanna Bore, at 2,970 ft. Victoria—Apollo Bay; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Barrabool Hills; Wonthaggi State Coal Mine Area, localities (a), (b), (c^3), (e^2); Cape Paterson; Berry Creek Bore No. 7, samples 17, 65, 68 and 72, Bore 18, at 278 ft.; Tyers Bore No. 2, at 860 ft., 1,000 ft. and 1,100 ft.; San Remo; Whitelaw Railway Station; Alberton West Bore No. 137, at 174 ft.

Comments. The original description of *N. truncatus* is as follows: "Spore tetrahedral, trilete, subtriangular in polar view, about 31-55μ in diameter; exospore ornamented with coarse, evenly spaced truncate processes about 3·5μ long, tetrad-scar reaching the periphery."

Upon the study of further specimens from the type locality it has been discovered that the processes are not equally developed over the entire surface of the spore, but on the proximal surface are less numerous, thinner and baculate. The larger truncate processes of the distal surface are from 3-5μ long and broaden considerably towards their points of insertion; the tetrad-scar is slightly raised above the surface.

Geological Range. Neocomian-Aptian to Albian.

Comments. N. truncatus differs from *N. neozealandica* (Couper) of New Zealand Jurassic beds in shape, the stronger development of the tetrad-scar and the smaller size of the truncate processes.

Genus **Ceratosporites** gen. nov.

Description. Spore tetrahedral, trilete, distal surface ornamented by blunt or sharply pointed processes, proximal surface smooth.

Genotype. Ceratosporites equalis sp. nov.

Ceratosporites equalis sp. nov.

(Pl. XIV, figs. 17-20; holotype, figs. 17-19)

Occurrence. South Australia—Cootabarlow Bore No. 2, at 1,354 ft. and 1,465 ft.; Robe Bore, 3,325-4,300 ft.; Kopperamanna Bore, at 2,970 ft. Victoria—Bellarine, Little's Shaft No. 2, 38-47 ft.; Apollo Bay; San Remo; Cape Paterson; Wonthaggi State Coal Mine Area, localities (a), (b), (c^3), (d), (e^2); Korumburra shale above coal seam; Whitelaw Railway Station; Berry Creek Bore No. 18, at 278 ft., and

Bore 7, samples 10, 17, 18, 19, 65 and 68; Tyers Bore No. 2, 850-1,150 ft.; Alberton West Bore No. 137, at 174 ft. Queensland—Styx Coal Measures, Bore No. 21, at 327 ft.

Description. Spore tetrahedral, trilete, subtriangular in polar view; tetrad-scar prominent and raised by a low tecta, laesurae extending to the margin. Exine thin, proximal surface unornamented, distal surface with rather closely spaced thin, straight-sided, blunt, capitate or occasionally bifurcate processes.

Dimensions. Equatorial diameter 32-52μ, processes 3-7μ long, 1-2μ wide.

Comments. The affinity of *Ceratosporites equalis* appears to be with the Lycopodiales and more particularly with the Selaginellaceae. In the nature and distribution of the ornament, it resembles spores of the *Selaginella latifron* group (Knox 1950) and to a lesser extent those of *Lycopodium densum* La Billard (Knox 1950)

The geological range of *C. equalis* is from Neocomian-Aptian to Albian, but so far it has not been recovered from the typical Albian deposits of the Artesian Basin.

Genus **Pilosisporites** Delcourt and Sprumont 1955

Pilosisporites notensis sp. nov.

(Pl. XV, figs. 1-3; holotype, fig. 1)

Occurrence. South Australia—Robe Bore, 4,300-1,400 ft.; Cootabarlow Bore No. 2, 1,354-581 ft.; Tilcha Bore, at 1,040 ft. and 460 ft.; Loxton Bore, at 1,470 ft.; Comaum Bore, at 708 ft. Victoria—Nelson Bore, at 6,485 ft.; Dergholm Bore No. 1, at 532 ft.; Barongarook Creek near Colac; Apollo Bay; Barrabool Hills; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Berry Creek Bore No. 18, at 278 ft.; Cape Paterson; Wonthaggi State Coal Mine Area, localities (a), (b), (c^3), (e^2); Korumburra shale above coal seam; Woodside Well No. 2, at 4,251 ft.; Hedley Well No. 2, at 4,251 ft.; Hedley Well No. 1, at 2,132 ft. New South Wales—Onepah Station Well. Queensland—Styx Coal Measures Bore No. 21, at 327 ft., and Bore No. 20, at 454 ft.; Weipa Bore No. 1, 2,022-41 ft.

Description. Spore trilete with a convex distal surface, a somewhat flattened proximal surface and a triangular amb with broadly rounded angles and straight to slightly concave sides. The laesurae of the tetrad-scar are distinctly rimmed and do not reach the equator. The exine is about 2·5-3·5μ thick, and invested with short straight-sided hairs or broad-based spinules *c.* 1·5-5μ long which are more densely arranged around the angles than on the proximal and the distal surfaces. Frequently, they are linearly arranged around the laesurae of the tetrad-scar.

Dimensions. Equatorial diameter 95-125μ; polar diameter of specimen shown in Pl. XIV, fig. 3, 81μ.

Comments. Pilosisporites notensis resembles, to some extent, the Belgian Wealden species *P. verus* Delcourt and Sprumont, but differs from it in having shorter and more evenly distributed surface projections. In *P. verus* the ornament takes the form of relatively long spines which are restricted to the angles of the spore whereas in *P. notensis*, it is in the form of more evenly distributed short hairs or spinules.

P. notensis is one of the most widely distributed types in the Upper Mesozoic deposits of eastern Australia and has been recovered from Lower Tertiary deposits in the Nelson Bore at 2,874 ft. and the Dartmoor Formation in south-western Victoria. Many of the Mesozoic deposits in which *P. notensis* occurs are now known to be of Albian age (Cookson and Dettmann 1958). Others, such as the freshwater shales associated with the black coal seams at Wonthaggi and Korumburra, which were previously assigned to the Lower Jurassic (Medwell 1954) on the basis of the contained macro plant remains are herein tentatively referred to as Lower Cretaceous (Neocomian-Aptian).

Genus **Kulyisporites** Potonié

Kulyisporites lunaris sp. nov.

(Pl. XIV, figs. 21-3; holotype, figs. 22, 23)

Occurrence. Victoria—Barrabool Hills; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Berry Creek Bore No. 18, at 278 ft.; Tyers Bore No. 2, at 860 ft.; Wonthaggi State Coal Mine Area, localities (b), (e^2).

Description. Spore trilete, equatorial outline varying from almost circular to subquadrangular or subtriangular with straight or convex sides; the laesurae of the tetrad-scar extend to the margin but are more prominent in the polar area. Exine finely granular, usually with a few coarser granules on each contact face. The most conspicuous feature is the presence on both proximal and distal surfaces of half-moon shaped ridges or scutula, the number of which may be the same on both surfaces, or greater on the distal surface than on the proximal surface, the number varies from 1-3 per contact area.

Dimensions. Equatorial diameter 30-54μ; diameter of areas enclosed by the scutula from 5-7μ.

Comments. The occurrence of small scutula on the spore surface of *Kulyisporites lunaris* is reminiscent of the spores of certain living species of *Hemitelia* and of the type from the Upper Tertiary of Trinidad referred to as "*Hemitelia* type", by Kuyl, Muller and Waterbolk (1955), and as *Kulyisporites waterbolki* by Potonié (1956). However, in *K. lunaris*, the scutula appear to be restricted to the polar surfaces whereas in *Hemitelia grandifolia* Willd., for example, they are situated, according to Erdtman (1943), "either near the margin of the distal part of the grain, or in the transition between the distal and the proximal part".

K. lunaris has been recovered only from a few Victorian deposits, the age of which ranges from Neocomian-Aptian to Albian.

Infraturma Murornati Potonié and Kremp 1954

Genus **Radiatisporites** gen. nov.

Description. Spore trilete with an open-meshed reticulum, the muri of which are considerably elongated, those of the proximal surface radiating from the laesurae of the tetrad-scar to the periphery, those of the distal surface lying either tangentially or obliquely to the margin.

Genotype. Radiatisporites hughesi sp. nov.

Radiatisporites hughesi sp. nov.

(Pl. XV, figs. 4-6; holotype, fig. 4)

Occurrence. South Australia—Robe Bore, at 3,860 ft. and 4,300 ft.; Comaum Bore, at 708 ft.; Cootabarlow Bore No. 2, at 1,465 ft.; Kopperamanna Bore, at 2,970 ft. Victoria—Cape Paterson; Wonthaggi State Coal Mine Area, localities (a), (b), (c); Korumburra shale above coal; Whitelaw Railway Station; Berry Creek Bore No. 7, samples 17, 18, 65, and 68.

Description. Spore trilete, amb subtriangular to subcircular, laesurae of tetrad-scar extending to the margin. Exine thin, ornamented on both surfaces by a deep reticulum having narrow, elongated, sometimes sinuous muri and wide lumina. On the proximal surface the muri radiate from a thickened ridge which runs parallel to the laesurae of the tetrad-scar and sometimes bifurcate before reaching the margin (Pl. XV, fig. 4); on the distal surface their direction is variable (Pl. XV, fig. 6).

Dimensions. Equatorial diameter 40-65μ; lumina of reticulum, proximal surface *c.* 5μ × 20μ, distal surface *c.* 6μ × 22μ.

Geological Range. Lower Cretaceous (Neocomian-Aptian).

The specific name is in honour of Mr. N. F. Hughes, Sedgwick Museum, Cambridge.

Genus **Ischyosporites** Balme 1957

Ischyosporites scaberis sp. nov.

(Pl. XV, figs. 7-9; holotype, figs. 8-9)

Occurrence. South Australia—Robe Bore, 4,300-2,630 ft.; Loxton Bore, at 1,470 ft. and 1,410 ft.; Comaum Bore, at 708 ft. Victoria—Dergholm Bore No. 1, at 532 ft.; Gellibrand River (Devil's Kitchen); Apollo Bay; Bellarine, Little's Shaft No. 2, 38-47 ft.; Barrabool Hills; San Remo; Wonthaggi State Coal Mine Area, localities (a), (b), (c^1), (c^3), (e^2), (d); Cape Paterson; Tyers Bore No. 2, 860-1,200 ft.; Berry Creek Bore No. 7, samples 17, 18, 19, 65, 68, Bore 18, at 278 ft.; Whitelaw Railway Station; Alberton West Bore No. 137, at 174 ft.; Woodside Well No. 2, at 4,251 ft. and 6,402 ft. Queensland—Styx Coal Measures Bore No. 20, at 454 ft.

Description. Spore trilete, amb broadly triangular to subcircular, sides convex; tetrad-scar not strongly marked, laesurae reaching the margin. Exine 4-6μ thick, proximal surface with coarse granules and low broad sinuous ridges, distal surface granular and with coarse ridges of uneven width (*c.* 4-7μ wide) which anastomose to form a more or less perfect reticulum.

Dimensions. Equatorial diameter 38-54μ; diameter of lumina of reticulum 4-11μ.

Comments. Ischyosporites scaberis differs from the genotype *I. craterus* Balme from West Australian Upper Mesozoic deposits in having a roughened and evenly thickened exine.

I. scaberis has a wide geographical distribution in eastern Australia; its geological range is from Neocomian-Aptian to Albian, but it is more frequent in the older deposits.

Ischyosporites punctatus sp. nov.

(Pl. XVI, figs. 1-4; holotype, fig. 1)

Occurrence. Western Australia—Broome No. 1 Bore, at 977 ft. South Australia—Cootabarlow Bore No. 2, 1,354-465 ft.; Kopperamanna Bore, at 2,970 ft.; Loxton Bore, at 1,410 ft. Victoria—Wonthaggi State Coal Mine, locality (b).

Description. Spore tetrahedral, trilete, amb triangular with more or less straight sides; laesurae almost reaching the periphery. Exine 2-3μ, thicker (3-5μ) at the angles, ornamented on the distal surfaces by an irregular reticulum with heavy muri and widely spaced lumina, the diameter of which range from 2-6μ; proximal surface punctate in the vicinity of the tetrad-scar otherwise unornamented.

Dimensions. Equatorial diameter 52-63μ.

Comments. This is a rare type in south-eastern Australian deposits. Apart from the single specimen recovered from the Albian deposit in the Loxton Bore at 1,410 ft., it seems to be restricted to Lower Cretaceous (pre-Albian) deposits. In Western Australia it has been observed in the Aptian deposit intersected by the Attadale Artesian Bore in the Perth metropolitan area at 809 ft., and in Upper Jurassic sediments in the Broome No. 1 Bore at 977 ft.

I. punctatus is readily distinguishable from *I. craterus* and *I. scaberis* by the fine pitting on the proximal surface.

Genus **Lycopodiumsporites** Thiergart 1938

Lycopodiumsporites austroclavatidites (Cookson)

(Pl. XV, fig. 12)

Lycopodium austroclavatidites Cookson 1953. *Aust. J. Bot.* 1: 469 (Pl. II, fig. 35).
Lycopodiumsporites austroclavatidites (Cookson) Potonié 1956. *Geol. Jahrb.* 23: 46.

Occurrence. South Australia—Robe Bore, 1,780-4,300 ft.; Cootabarlow Bore No. 2, at 1,354 ft. and 1,465 ft.; Comaum Bore, 651-708 ft.; Kopperamanna Bore, at 2,970 ft. Victoria—Birregurra Bore No. 1, at 1,089 ft. and 1,102 ft.; Barrabool Hills; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Cape Paterson; Wonthaggi State Coal Mine Area, localities (a), (b), (c), (d), (e^2); Korumburra, shale above coal; Whitelaw Railway Station; Berry Creek Bore No. 18, at 278 ft., Bore No. 7, samples 17, 65 and 68; Alberton West Bore No. 137, at 174 ft.

Comments. Spores which may be referred to this species are common throughout the Upper Mesozoic sediments examined during this investigation and therefore appear to be of little stratigraphical value. The rephotographed holotype is illustrated in Pl. XV, fig. 12.

Lycopodiumsporites circolumenus sp. nov.

(Pl. XV, figs. 10, 11; holotype, figs. 10, 11)

Occurrence. Western Australia—Broome No. 1 Bore, at 977 ft. South Australia—Cootabarlow Bore No. 2, 1,354-465 ft.; Kopperamanna Bore, at 2,970 ft.; Robe Bore, 3,860-4,300 ft. Victoria—Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; San Remo; Wonthaggi State Coal Mine Area, localities (a), (b), (d); Berry Creek Bore No. 7, samples 18, 65; Whitelaw Railway Station, Woodside Well No. 2, at 6,402 ft.

Description. Microspore trilete, biconvex, amb subtriangular to almost circular. Tetrad-scar prominent, the laesurae sinuous, raised by a low tecta and extending to the margin. Exine *c.* 2-3μ thick, smooth on the proximal surface and reticulate on the distal surface. The muri of the reticulum are *c.* 1-2μ wide and enclose almost circular or sometimes polygonal lumina *c.* 4-7μ in diameter.

Dimensions. Equatorial diameter 45-60μ.

Comments. Of the species of *Lycopodiumsporites*, *L. circolumenus* seems closest to *L. agathoecus* (R. Potonié) Thiergart. However, it differs from this species in the nature of the tetrad-scar and smaller size. Although *L. circolumenus* has been recovered from the Albian deposit in Little's Shaft, Bellarine Peninsula, it seems to be more typical of the older Neocomian-Aptian deposits. In Western Australia it has been observed in the Aptian deposit in the Attadale Bore at 999 ft., and in the Upper Jurassic deposit in the Broome No. 1 Bore at 977 ft.

Genus **Cicatricosisporites** Potonié and Gelletich 1933

Cicatricosisporites australiensis (Cookson)

(Pl. XV, figs. 13, 14; holotype, fig. 13)

Mohriorisporites australiensis Cookson 1953. *Aust. J. Bot.* 1: 470 (Pl. II, figs. 31-4).
Cicatricosisporites australiensis (Cookson) Potonié 1956. *Geol. Jahrb.* 23: 48.

Occurrence. South Australia—Robe Bore, 1,400-3,860 ft.; Cootabarlow Bore No. 2, at 581 ft., 810 ft. and 1,354 ft.; Tilcha Bore, at 460 ft. and 1,040 ft.; Loxton Bore, at 1,410 ft. and 1,470 ft.; Comaum Bore, at 651 ft. and 708 ft. Victoria—Dergholm Bore No. 1, at 532 ft., Bore No. 2, at 329 ft.; Barongarook Creek; Birregurra Bore No. 1, at 1,089 ft. and 1,102 ft.; Gellibrand River (Devil's Kitchen); Apollo Bay; Nelson Bore No. 1, 5,782-6,485 ft.; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Barrabool Hills; Wonthaggi State Coal Mine Area, localities

(a), (b), (c^3), (e^2); Korumburra above coal seam; Cape Paterson; Berry Creek Bore No. 7, samples 18 and 19, Bore 18, at 278 ft.; Tyers Bore No. 2, 850-1,200 ft.; Whitelaw Railway Station; Woodside Well No. 2, 4,117-6,402 ft.; Hedley Bore No. 1, 1,460-2,132 ft.; Alberton West Bore No. 137, 174-8 ft., Bore 159, 250-65 ft. New South Wales—Onepah Station Well. Queensland—Styx Coal Measures Bore No. 21, at 327 ft., Bore No. 20, at 454 ft. Papua—Omati Bore, samples 1 and 2 (Cookson and Eisenack 1958).

Description. For completeness, the diagnosis of *Cicatricosisporites australiensis* as given by Cookson (1953) has been included. "Spores tetrahedral with rounded angles; trilete 35-50 × 29-34μ, tetrad-scar reaching the periphery, exospore ornamented with narrow ridges which run parallel to the walls of the spore." This description was accompanied by illustrations of four syntypes. In the absence of a specified holotype we designate the example shown in Cookson's Pl. II, fig. 32 as holotype and refigure it in Pl. XV, fig. 13.

Comments. Cicatricosisporites australiensis has been found to be one of the most wide-spread of the trilete species present in the Cretaceous beds of the eastern Australian region, with a southerly extension from Papua to southern Victoria and South Australia. Most of the deposits in which *C. australiensis* occurs are Lower Cretaceous but in Victoria it is known from the Upper Cretaceous section of the Nelson Bore (Baker and Cookson 1955) and during this investigation has been isolated from Victorian Upper Mesozoic coals and their associated shales which were assigned to the Lower Jurassic by Medwell (1954a) and are herein referred to as Neocomian-Aptian.

In Papua, *C. australiensis* occurs in the upper samples of the Albian-Aptian section of the Omati core but not in the Upper Jurassic section. In Queensland, *C. australiensis* is relatively abundant in the Lower Cretaceous (Albian) Styx Coal Measures, less frequent in the slightly older Burrum coals and absent altogether, as Dr. N. J. de Jersey has kindly informed us, from the Rosewood coals (Lower Jurassic).

Similarly in South Australia, a numerical decrease with depth is noticeable in both the Robe and Cootabarlow Bores. In the latter *C. australiensis* is well represented in the Albian deposit intersected at 581 ft., infrequent in the Aptian deposit at 1,354 ft. and apparently absent from the sample taken at 1,465 ft.

The occurrence of *C. australiensis* in Western Australia seems to be less frequent than it is in eastern Australia. Balme (1957) reports that it "was not found in any of the samples known definitely to be pre-Cretaceous and was rare in assemblages in which it did occur in Western Australia". More recently, the same author (Balme pers. comm.) has noted fairly large numbers of the species in sediments immediately underlying the Molecap Greensand in the Gingin area. The age of these sediments is uncertain but from their stratigraphical relationships they can hardly be older than Aptian.

From the above, it is evident that, while *C. australiensis* is typically a Cretaceous species, it cannot be used, at least in Victoria, as an index of Cretaceous age while the present uncertainty exists regarding the age of the Wonthaggi deposits.

Genus **Dictyotosporites** gen. nov.

Description. Microspore trilete, tetra-scar inconspicuous prior to opening, laesurae reaching or almost reaching the margin. Exine ornamented on both surfaces by a reticulate membrane, consisting of a primary reticulum and one or more superimposed reticula.

Genotype. Dictyotosporites specious.

Dictyotosporites speciosus sp. nov.

(Pl. XVI, figs. 5-10; holotype, fig. 5)

Occurrence. South Australia—Robe Bore, at 3,860 ft. and 4,300 ft.; Cootabarlow Bore No. 2, at 1,354 ft. and 1,465 ft.; Comaum Bore, at 708 ft. Victoria—Apollo Bay; Cape Paterson; Whitelaw Railway Station; Wonthaggi State Coal Mine Area, localities (a), (b), (c^3), (e^1), (e^2); Korumburra locality (a); Berry Creek Bore No. 7, sample 19.

Description. Spore trilete, distal surface convex; proximal surface almost flat; amb broadly triangular to almost circular; laesurae of tetrad-scar unthickened sometimes reaching the periphery. Exine 2-7μ thick, consisting of an inner apparently homogeneous layer from which the primary muri arise and an outer lace-like zone consisting of one or two finer reticula formed as the result of the fusion of the subdivisions of the primary and secondary muri respectively.

Dimensions. Overall equatorial diameter 41-63μ; equatorial diameter 37-55μ.

Geological Range. Lower Cretaceous (pre-Albian).

Dictyotosporites complex sp. nov.

(Pl. XVI, figs. 11-16; holotype, fig. 11. Pl. XVIII, fig. 1)

Occurrence. South Australia—Robe Bore, at 3,860 ft.; Cootabarlow Bore No. 2, at 1,465 ft.; Kopperamanna Bore, at 2,970 ft. Victoria—Wonthaggi State Coal Mine Area, locality (b).

Description. Spore trilete, biconvex, amb approximately circular, tetrad-scar inconspicuous, laesurae reaching the periphery. Exine of variable width consisting of two layers, an inner thin, apparently homogeneous layer and an outer reticulate membrane, composed of two or more superimposed reticula. The lumina of the outer membrane are always minute and either uniform or variable in size in which case the smallest are always those adjacent to the spore wall. The outer network is attached to the inner layer of the exine by thread-like processes which bifurcate distally. (Pl. XVI, figs. 15, 16.)

Dimensions. Overall equatorial diameter 42-69μ; equatorial diameter of spore 35-45μ; width of reticulate membrane 4-15μ.

Comments. Dictyotosporites complex can be distinguished from *D. speciosus* in having a thinner and more transparent reticulate outer membrane, more delicate primary exinous outgrowths and in an increase rather than a decrease in the size of the mesh towards the margin.

In typical examples of *D. complex*, the mesh of the reticulate membrane is so small that it can be seen only at a magnification of 1,000 or more diameters. In the spores shown in Pl. XVI, figs. 12, 16, both of which appear to have the same type of construction as *D. complex*, the meshwork is clearly visible at a magnification of about 500 diameters. It is possible that these spores may represent another species. However, until the limits of variation in this respect can be more clearly defined by the study of a larger number of examples of both types, the two apparently atypical forms are compared rather than identified with *D. complex*.

Some difficulty has been experienced in the morphological interpretation of *D. complex*. When first observed it was thought that the reticulate covering of the spore was in the nature of a perine. However, the later discovery of numerous thread-like supporting projections from the surface of the inner apparently homogeneous layer of the exine of a specimen from which the reticulate membrane had been partially detached has proved it to be exinous in origin (Pl. XVI, figs. 15, 16).

In eastern Australia *D. complex* seems to be restricted to deposits of Lower Cretaceous (Neocomian-Aptian) age. The authors have also observed it in sediments situated at 963-77 ft. in the Broome No. 1 Artesian Bore in Western Australia, the age of which, on the grounds of the contained microplankton, is almost certainly uppermost Jurassic.

Infraturma Perinotriliti Erdtman 1947

Genus **Perotrilites** (Erdtman) ex Couper 1953

Perotrilites striatus Cookson and Dettmann

(Pl. XVI, figs 17-18)

Occurrence. South Australia—Robe Bore, 3,500-1,400 ft.; Cootabarlow Bore No. 2, at 581 ft. and 810 ft.; Tilcha Bore, at 1,040 ft. and 460 ft.; Loxton Bore, at 1,410 ft.; Comaum Bore, at 708 ft. Victoria—Dergholm Bore No. 1, at 582 ft. and 532 ft., Bore No. 2, at 329 ft.; Barongarook Creek; Birregurra Bore No. 1, at 1,089 ft., 1,099 ft. and 1,102 ft.; Gellibrand River (Devil's Kitchen); Barrabool Hills; Bellarine Peninsula, Little's Shaft No, 2, 38-47 ft.; Woodside Well No. 2, at 6,402 ft.; Hedley Well No. 1, at 2,132 ft. New South Wales—Onepah Station Well. Queensland—Styx Coal Measures Bore No. 21, at 327 ft., Bore No. 20, at 454 ft. Papua—Omati Bore, samples 1 and 2 (Cookson and Eisenack 1958).

Comments. When this species was described (Cookson and Dettmann 1958) only those localities in which the megaspore genus *Pyrobolospora* Hughes also occurred, were recorded. *Perotriletes striatus* has a wide geographical distribution in the eastern Australian region but appears to have a restricted geological range. So far all the deposits in which it has been found are Lower Cretaceous and mostly Albian.

P. striatus seems to have a close connection with the species of *Pyrobolospora* which, almost invariably, are to be found in the same deposits, and frequently has been observed amongst the proximal "leaves" which characterize these genus. The affinity of *P. striatus* with the Hydropteridae has already been discussed (Cookson and Dettmann 1958).

Subturma Pyrobolotriletes R. Potonié 1956

Genus **Pyrobolospora** Hughes

Pyrobolospora reticulata Cookson and Dettmann

During the present investigation examples of this type of megaspore have been found in three additional Victorian deposits. Its known distribution is now as follows: South Australia—Robe Bore, at 1,400 ft.; Cootabarlow Bore No. 2, at 581 ft.; Loxton Bore, at 1,410 ft.; Tilcha Bore, at 1,040 ft. Victoria—Dergholm Bore No. 1, at 532 ft., Bore No. 2, at 329 ft.; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft. New South Wales—Onepah Station Well.

P. reticulata appears to be restricted to deposits of Albian age.

Pyrobolospora nuda Cookson and Dettmann 1958

This species which was originally described from the Tilcha Bore at 460 ft., has since been recovered from the Robe Bore at 1,400 ft.

? Subturma Pyrobolotriletes Potonié 1956

Genus **Balmeisporites** Cookson and Dettmann

Balmeisporites holodictyus Cookson and Dettmann

The distribution of this species has been somewhat extended during the present investigation and is now known to include the following deposits: South Australia —Robe Bore, at 1,400 ft. and 1,780 ft.; Loxton Bore, at 1,410 ft.; Cootabarlow Bore No. 2, at 581 ft.; Tilcha Bore, at 460 ft. and 1,040 ft. Victoria—Barongarook Creek; Birregurra Bore No. 1, at 1,089 ft. and 1,102 ft.; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Barrabool Hills. New South Wales—Onepah Station Well. Queensland—Styx Coal Measures Bore 21, at 327 ft., Bore 20, at 454 ft. Papua—Omati Bore No. 1, sample 2.

All these deposits are of Lower Cretaceous (probably Albian) age.

Turma Zonales (Bennie and Kidston 1886) R. Potonié 1956

Subturma Auritotriletes Potonié and Kremp

Infraturma Auriculati (Schopf) Potonié 1954 and Kremp 1954

Genus **Trilobosporites** (Pant) ex Potonié 1956

Trilobosporites trioreticulosus sp. nov.

(Pl. XVII, figs. 1-3; holotype, fig. 3)

Occurrence. South Australia—Cootabarlow Bore No. 2, at 1,354 ft. and 810 ft.; Tilcha Bore, at 1,040 ft. and 460 ft.; Robe Bore, 1,780 ft. and 1,400 ft. Victoria—Barongarook Creek; Birregurra Bore, at 1,102 ft.; Gellibrand River (Devil's Kitchen); Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Barrabool Hills. New South Wales—Onepah Station Well. Queensland—Styx Coal Measures Bore No. 21, at 327 ft., Bore No. 20, at 454 ft.

Description. Spore trilete; amb triangular with broadly rounded angles and straight to slightly concave sides; the laesurae of the tetrad-scar are usually strongly rimmed and extend about half-way to the equator. The exine is about 2·5-3μ thick and closely covered with scabrae or coarse granules. In addition a shallow reticulum with polygonal lumina and coarse and somewhat sinuous muri is developed at and around the angles of the spore.

Dimensions. Equatorial diameter 70-85μ.

Geological Range. Lower Cretaceous (Albian-Aptian).

Comments. Trilobosporites trioreticulosus is readily distinguishable from other trilete microspores by the coarse reticulum present at the angles. It seems to have a more restricted vertical distribution than many of the Australian Upper Mesozoic microspores, present indications pointing to an Albian-Aptian time range.

Subturma Zonotriletes Waltz 1935

Infraturma Cingulati R. Potonié and Klaus 1954

Genus **Cingulatisporites** Thomson 1953

Cingulatisporites euskirchensoides Delcourt and Sprumont

(Pl. XVII, figs. 4-6)

Occurrence. Western Australia—Moora Bore, 86-170 ft. South Australia—Cootabarlow No. 2 Bore, at 1,354 ft. and 581 ft.; Tilcha Bore, at 1,040 ft.; Loxton Bore, at 1,410 ft.; Robe Bore, at 3,500 ft., 3,325 ft., 2,325 ft., 1,780 ft. and 1,400 ft.

Victoria—Birregurra Bore No. 1, at 1,102 ft., 1,096 ft. and 1,089 ft.; Dergholm Bore No. 1, at 532 ft., Bore No. 2, at 329 ft.; Barongarook Creek; Gellibrand River (Devil's Kitchen); Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Tyers Bore No. 2, at 860 ft.; Woodside Well No. 2, at 4,251 ft. New South Wales—Onepah Station. Queensland—Styx Coal Measures Bore No. 20, at 454 ft. Papua—Omati Bore, sample 2 (Cookson and Eisenack 1958).

Description. The spores referred to *Cingulatisporites euskirchensoides* are rounded to ovoid in polar view and have a delicate equatorial flange from *c.* 2·5-5μ wide and a more or less branched tetrad-scar. The exine is *c.* 1·5μ thick, and finely granular.

Dimensions. The equatorial diameter of the spore is 40-55μ and the overall equatorial diameter 50-60μ.

Comments. The Australian representatives of *C. euskirchensoides* agree closely with the examples described in 1955 by Delcourt and Sprumont from Wealden deposits in Hainaut, Belgium. They are widely distributed throughout eastern Australia and extend to Papua, New Guinea, but seem to be restricted to beds of Albian-Aptian age.

Cingulatisporites simplex sp. nov.

(Pl. XVII, figs. 7, 8; holotype, fig. 8)

Occurrence. South Australia—Tilcha Bore, at 1,040 ft.; Robe Bore, at 2,630 ft. and 1,400 ft. Victoria—Dergholm Bore No. 1, at 532 ft.; Birregurra Bore No. 1, at 1,102 ft., 1,096 ft. and 1,089 ft.; Barongarook Creek; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.

Description. Spores trilete rounded to ovoid in polar view with a finely granular, transparent, equatorial flange of uneven width (*c.* 1·5-5μ). Exine *c.* 3μ thick, smooth; tetrad-scar distinct, the laesurae unbranched, extending either to or almost to the equator.

Dimensions. Equatorial diameter of spore 40-58μ; overall equatorial diameter 43-65μ.

Geological Range. Lower Cretaceous (probably Albian).

Comments. Cingulatisporites simplex is very similar to *C. euskirchensoides* Delcourt and Sprumont from the Wealden of Belgium only differing from this species in having an unbranched tetrad-scar. There is little doubt that the two forms are closely related and it is even possible that they are variants of one species. *C. simplex* has only been observed in deposits in which *C. euskirchensoides* is also present, but seems to have a more limited distribution than the latter.

Cingulatisporites paradoxus sp. nov.

(Pl. XVII, figs. 9-13; holotype, fig. 10)

Occurrence. South Australia—Robe Bore, 1,400-2,630 ft.; Cootabarlow Bore No. 2, at 581 ft. and 1,354 ft.; Tilcha Bore, at 460 ft. and 1,040 ft. Victoria—Dergholm Bore No. 1, at 532 ft.; Barongarook Creek; Birregurra Bore No. 1, 1,079-89 ft., 1,089-90 ft., and at 1,102 ft.; Gellibrand River (Devil's Kitchen); Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Barrabool Hills; Woodside Well No. 2, at 4,251 ft. New South Wales—Onepah Station Well.

Description. Spore alete, occasionally with faint indications of a tetrad-scar, flattened, subtriangular to almost circular in polar view, with convex sides, sometimes asymmetrical. Cingulum narrow, delicate and granular often partially, or wholly destroyed. Exine 1·5-3μ thick, 2-layered, scabrate to granulate usually, with a secondary pattern, at and around one of the poles, resulting from the development of

minute fractures which delimit one to several well-defined hexagonal areas; sometimes a distinct fovea with a rather irregular outline is formed by the further breakdown of the exine in this region.

Dimensions. Equatorial diameter 41-60μ, width of cingulum 1-3μ.

Comments. Cingulatisporites paradoxus is a readily recognizable form and, since it appears to be restricted to deposits of Albian-Aptian age, is likely to prove a useful index fossil.

As far as the morphology of *C. paradoxus* is concerned, some uncertainty exists regarding three of its main features: (1) The apparent absence of the tetrad-scar from the majority of examples (some 100 specimens at least have been examined) suggests that the alete condition is normal for this species. However, doubt in this connection has been created by the occasional appearance of what have been taken as faint laesurae. (2) The readily destructable nature of the equatorial flange, here interpreted as a cingulum (it is absent from a large proportion of examples), suggests the possibility that it may be of perinous nature. (3) The occasional occurrence of a fovea in the position usually occupied by the "secondary pattern" raises the question as to whether it is a natural or accidental opening and, if the former, whether it is developed on the distal surface, as in *Cirratriradites* Wilson and Coe or on the proximal surface as an opening mechanism in place of a normal tetrad-scar.

Genus **Lycospora** Schopf, Wilson and Bentall 1944

Lycospora mollis sp. nov.

(Pl. XVII, figs. 14-17; holotype, fig. 14)

Occurrence. South Australia—Robe Bore, at 3,860 ft.; Kopperamanna Bore, at 2,970 ft. Victoria—Birregurra Bore No. 1, 1,089-90 ft.; Apollo Bay; Barrabool Hills; Woodside Well No. 2, at 4,251 ft.; Wonthaggi State Coal Mine Area, locality (b).

Description. Spore radially symmetrical, trilete, globose, with a thin, narrow subequatorial ridge which is situated slightly nearer the distal than the proximal surface; the laesurae of the tetrad-scar are narrowly rimmed and extend almost to the marginal ridge. The exine is thin and granular.

Dimensions. Equatorial diameter 30-52μ; polar diameter 32-48μ.

Geological Range. Lower Cretaceous, Neocomian-Aptian and Albian.

Comments. Since all the species previously referred to the genus *Lycospora* have been of Carboniferous age and some, at least, have been isolated from cones of *Lepidostrobus* and *Lepidocarpon*, it was only after much consideration and hesitation that we decided to refer an Australian Upper Mesozoic dispersed form to this particular genus. Our main reasons for doing so were the close agreement that seems to exist between this form and the description and representation of *Lycospora* given by Schopf, Wilson and Bentall (1944, p. 54, Pl. III, fig. 19) and the consequent difficulty of providing a generic description that would be adequately distinct from that of *Lycospora*. [During the publication of this paper a Liasso-Rhaetic trilete spore has been referred to *Lysospora* (Harris, T. M., 1957. *Proc. Roy. Soc.* 147: 305).]

However, in view of the diverse differences in age and geographical location, no attempt has been made to compare *L. mollis* with any of the northern Paleozoic species.

L. mollis is almost invariably more or less deformed in glycerine jelly mounts and is better examined when resting freely in a 50 per cent solution of glycerine and water. The photographs shown in Pl. XVII, figs. 14-17 are of unmounted examples.

Infraturma Zonati Potonié and Kremp 1954

Genus **Cirratriradites** Wilson and Coe 1940

Spores referable to the genus *Cirratriradites*, as redefined by Potonié and Kremp (1954), occur, generally in relatively small numbers, in a variety of Australian Upper Mesozoic deposits. Such spores have a relatively wide equatorial flange, and frequently a more or less well developed fovea on the distal surface. In some examples the distal wall is entire, but when this is the case the position in which the fovea is usually developed is indicated either by the greater density or more regular arrangement of the ornament at the distal pole.

Thus the present study shows that, in the Australian Mesozoic representatives of *Cirratriradites*, the distal opening is formed by the natural break-down of the exospore in a circumscribed preformed area, and that, as it is a developmental feature, neither its presence nor absence can be used for the characterization of individual species.

For this purpose dependence has had to be placed on the type of exospore sculpturing, a feature which, unfortunately, is considerably variable in these forms. Two types of sculptural element are distinguishable: (1) broad-based spinules; (2) coarse granules or verrucae. In both of these categories we have found and made allowance for considerable variation, but in doing so it is possible that spores of more than one species have been included in the three spore-species herein distinguished.

Cirratriradites is typically a late Paleozoic genus, most of the species having come from the Carboniferous of Europe and North America. An Australian Permian species *Cirratriradites splendens* has recently been described by Balme and Hennelly (1957). As far as we are aware no Mesozoic species of *Cirratriradites* have been previously recorded. One of our species shows a resemblance to *Aequitriradites inconspicuus* Delcourt and Sprumont from the Wealden of Belgium, the illustrated example of which shows a distinct opening in the exospore. However, M. Delcourt has kindly informed us that he regards the opening in this specimen as accidental and that the genus *Aequitriradites* is characterized by the absence of a fovea.

Cirratriradites verrucosus sp. nov.

(Pl. XVIII, figs. 2-6; holotype, figs. 5, 6)

Occurrence. South Australia—Robe Bore, 1,400-2,325 ft.; Cootabarlow Bore No. 2, at 581 ft. Victoria—Dergholm Bore No. 1, at 532 ft.; Birregurra Bore No. 1, at 1,089 ft. New South Wales—Onepah Station Well. Queensland—Styx Coal Measures, Bore No. 20, at 454 ft., Bore No. 21, at 327 ft.; Weipa Bore No. 1, 2,022-41 ft.

Description. Spore trilete, biconvex (flattened at the poles) with a subtriangular amb and with or without a fovea at the distal pole. The equatorial flange is moderately wide and rather thin and membranous with a dotted surface and sometimes a serrated margin. The laesurae of the tetrad-scar extend as narrow ridges from the outer edge of the flange along the proximal surface to end at varying distances from the pole. The exine is 2-3μ thick and inconspicuously granulate to verrucate. In specimens in which the exine is entire, i.e. when a fovea has not been developed, a circular area in which the sculptural elements are strongly outlined and frequently radially arranged is evident at and around the distal pole. In those examples in which a fovea is present the break-down of the exine, to which the opening is due, has occurred invariably in this area, some of the verrucae of which usually remain around its margin.

Dimensions. Overall equatorial diameter 65-98μ; equatorial diameter of spore-body 48-70μ; flange 9-16μ wide.

Geological Range. Lower Cretaceous (Aptian-Albian).

Cirratriradites tilchaensis sp. nov.

(Pl. XVIII, figs. 7, 8; holotype, fig. 7)

Occurrence. South Australia—Tilcha Bore, at 460 ft.; Robe Bore, at 1,400 ft. and 3,860 ft. New South Wales—Onepah Station Well. Queensland—Styx Coal Measures, Bore No. 2, at 327 ft.

Description. Spore biconvex, amb broadly triangular to almost circular; zona almost smooth and generally rather thick; laesurae of tetrad-scar prominent but not extending to the pole. Exine about 2·5μ thick, distinctly verrucate in the vicinity of the distal pole where a fovea is frequently developed; otherwise faintly patterned.

Dimensions. Overall equatorial diameter 54-61μ; equatorial diameter spore 36-47μ; flange 5-7μ.

Geological Range. Lower Cretaceous, Neocomian-Aptian and Albian.

Comments. C. tilchaensis is similar in form to *C. verrucosus*, but differs in its smaller size and less clearly marked ornamentation.

Cirratriradites spinulosus sp. nov.

(Pl. XVIII, figs. 9-13; holotype, fig. 9. Pl. XIX, figs. 1-5)

Occurrence. South Australia—Robe Bore, 1,400-3,860 ft.; Tilcha Bore, at 460 ft.; Loxton Bore, at 1,410 ft. and 1,460 ft.; Cootabarlow Bore No. 2, at 581 ft.; Comaum Bore, at 708 ft. Victoria—Gellibrand River (Devil's Kitchen); Dergholm Bore No. 1, at 532 ft. and 582 ft.; Bore No. 2, at 329 ft.; Birregurra Bore No. 1, 1,089-102 ft.; Apollo Bay; Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft.; Wonthaggi State Coal Mine Area, localities (a), (b), (e^2); Tyers Bore No. 2, at 860 ft.; Berry Creek Bore No. 7, sample 68, Bore No. 18, at 278 ft.; Cape Paterson; Woodside Well No. 2, at 4,251 ft. and 6,402 ft. New South Wales—Onepah Station Well. Queensland—Styx Coal Measures Bore No. 21, at 327 ft,. Bore No. 20, at 454 ft.

Description. Spore elliptical in equatorial view, subtriangular to subcircular in polar view, with or without a distal fovea. The equatorial flange has a granular and occasionally spiny surface and a serrated margin. The rays of the tetrad-scar are variable in extent and prominence and may be absent altogether; in some specimens they are only visible on the flange, whereas in others they can be traced to within a short distance of the proximal pole. The exine which is about 2-4μ, is covered with rather regularly and radially arranged short broadly-based spinules or straight-sided projections with rounded apices which are usually more widely dispersed towards the equator and more densely arranged on the distal than on the proximal surface. In surface view, the bases of the projections are either circular or polygonal in outline and a distinct range in size from *c.* 1-4μ.

A distal fovea is frequently present; when not developed the surface projections are usually more crowded or more regularly arranged over the distal pole.

Dimensions. Overall diameter 54-107μ; spore body 37-86μ; flange 5-15μ.

Geological Range. Lower Cretaceous, Neocomian-Aptian and Albian.

Comments. Cirratriradites spinulosus as defined above is a broad type, which probably includes spores of more than one plant species. However, its subdivision into smaller units has not been attempted owing to the occurrence of "intermediates" and the consequent difficulty of deciding exactly where the lines of separation should be drawn.

The chief variants are the size and shape of the ornament and, to a lesser extent, the size of the spores themselves. In some specimens, including the type, the exinous outgrowths are slender, small-based, straight-sided cones (Pl. XVIII, figs. 9, 10, 13) or finger-like processes; in others, especially those from the Apollo Bay deposit (Pl. XIX, fig. 3), the proximal portions are much enlarged and the apices merely minute medianly placed points.

As regards size, the examples occurring in the Gellibrand River deposit (Devil's Kitchen) are consistently larger than those of other deposits.

C. spinulosus is similar to the West Australian species *Zonalisporites acusus* Balme in form and in having a polar fovea. However, *Z. acusus* differs in the smaller size of the spore and the complete absence of a tetrad-scar.

Genus **Minerisporites** R. Potonié 1956

Minerisporites marginatus (Dijkstra)

Triletes marginatus Dijkstra 1951. *Med. Geol. Sticht. n.s.* 5: 13 (Pl. III, fig. 11).
Baldurnisporites marginatus (Dijkstra) Delcourt and Sprumont 1955. *Mem. Soc. Belg. Geol. n.s.* 4: 73 (Pl. IV, fig. 5).
Minerisporites marginatus (Dijkstra) Potonié 1956. *Geol. Jahrb.* 23: 68.

Since the first Australian record of *M. marginatus* (Dijkstra) by Cookson and Dettmann (1958), this species has been isolated from several additional localities. The main features of these examples have been constant, the only variation being the degree of prominence of the surface reticulum. The distribution of *M. marginatus* as at present known is as follows: South Australia—Robe Bore, at 1,400 ft., 1,780 ft., 3,325 ft. and 3,860 ft.; Loxton Bore, at 1,410 ft.; Comaum Bore, at 708 ft.; Cootabarlow Bore No. 2, at 1,465 ft. Victoria—Barongarook Creek; Dergholm Bore No. 2, at 329 ft.; Wonthaggi State Coal Mine Area, localities (b), (e^2). New South Wales—Onepah Station Well.

Geological Range. Lower Cretaceous, Neocomian-Aptian and Albian.

Genus **Styxisporites** gen. nov.

Description. Microspore trilete with a membranous equatorial flange; tetrad-scar restricted to the spore-body, the laesurae tectate. Ornament in the form of spineous or blunt processes which are restricted to the distal surface.

The generic name refers to the Styx Coal Measures in Queensland, in certain shales of which one of the species is relatively abundant.

The spores comprising the genus *Styxisporites* are referred to the Infraturma Zonati rather than to the Infraturma Cingulati on account of the membranous nature of the equatorial flange (zona). However, no close agreement can be established with other microspore genera within this infraturma.

The two genera within the Zonati to which *Styxisporites* bears the closest resemblance are *Cirratriradites* Wilson and Coe and *Aequitriradites* Delcourt and Sprumont. However, *Styxisporites* differs from both these genera in the restriction of the tetrad-scar to the spore-body and the tectate nature of the laesurae and from *Cirratriradites* in the absence of ornamentation of the proximal surface.

Genotype. Styxisporites linearis.

Styxisporites linearis sp. nov.

(Pl. XIX, figs. 6-9; holotype, figs. 6, 7)

Occurrence. South Australia—Robe Bore, at 3,860 ft. Victoria—Wonthaggi localities (a), (b), (e^2).

Description. Spore trilete, subtriangular to subcircular; equatorial flange membranous 5-9μ wide with a serrated margin; tetrad-scar prominent, laesurae extending to the periphery of the spore-body. Exine thin, proximal surface smooth, distal surface ornamented by rather widely-spaced conical spines or more usually straight-sided blunt projections, which broaden slightly at the base.

Dimensions. Overall equatorial diameter 54-62μ; equatorial diameter of spore-body 43-49μ; length of exinous projections 7-9μ.

Geological Range. A rare type which appears to be restricted to deposits of Neocomian-Aptian age.

Styxisporites majus sp. nov.

(Pl. XIX, figs. 10-14; holotype, fig. 10)

Occurrence. Western Australia—Gearle Siltstone (lower part)—West Australian Petroleum Co.'s Rough Range Well No. 1, at 2,750 ft.; Moora Bore, 86-170 ft. South Australia—Tilcha Bore, at 460 ft. and 1,040 ft.; Cootabarlow Bore No. 2, at 581 ft.; Robe Bore, at 1,400 ft. Victoria—Birregurra Bore No. 1, at 1,089 ft. and 1,102 ft. New South Wales—Onepah Station Well. Queensland—Styx Coal Measures Bore No. 21, at 327 ft., Bore No. 20, at 450 ft.

Description. Spore trilete with a subtriangular to subcircular amb; the equatorial flange is relatively wide with a finely scabrate surface and serrated margin. The laesurae of the tetrad-scar are straight and extend to the periphery of the spore-body. The exine is about 1·5μ thick, smooth on the proximal surface and ornamented on the distal surface by rather widely-spaced conical spines or occasionally blunt straight-sided projections which usually arise from low ridges running parallel to the equatorial contour of the spore-body. Occasionally, as in the specimen shown in Pl. XIX, fig. 12, the ridges are more prominent and jagged and the spines reduced.

Dimensions. Overall equatorial diameter 60-79μ, equatorial diameter of spore-body 45-58μ, flange 9-16μ, length of spines 4-7μ.

Geological Range. Lower Cretaceous (Albian).

Comments. A few of the specimens from the Tilcha Bore and all those from Little's Shaft in the Bellarine Peninsula have smaller and more numerous spines than typical examples of *Styxisporites majus* (Pl. XIX, fig. 14). While it seems likely that they represent a distinct type too few of them have been recovered to justify specific separation.

S. majus differs from *S. linearis* in its larger size and in the presence of the low ridges from which the spines arise.

Spore Assemblages

As stated earlier, only a relatively small number of the trilete spore types present in the various deposits analysed have been described and classified. The lists included in this section give little idea of the microfloras as a whole and are included only as records and for comparative purposes.

A. Lower Cretaceous (Neocomian-Aptian)

1. South Australia
   (a) Robe Bore at 4,300 ft.
   Microspores—

Ceratosporites equalis
Dictyotosporites speciosus
Granulatisporites dailyi
Ischyosporites scaberis
Leptolepidites verrucatus
Lycopodiumsporites circolumenus
Lycopodiumsporites austroclavatidites
Neoraistrickia truncatus
Pilosisporites notensis
Radiatisporites hughesi

(b) Robe Bore at 3,860 ft.

Microspores—

Apiculatisporis wonthaggiensis
Ceratosporites equalis
Cicatricosisporites australiensis
Cirratriradites spinulosus
Cirratriradites tilchaensis
Dictyotosporites speciosus
Dictyotosporites complex
Granulatisporites dailyi
Ischyosporites scaberis
Leptolepidites verrucatus
Lycospora mollis
Lycopodiumsporites austroclavatidites
Lycopodiumsporites circolumenus
Neoraistrickia truncatus
Osmundacidites comaumensis
Pilosisporites notensis
Radiatisporites hughesi
Styxisporites lincaris

Megaspores—

Minerisporites marginatus

(c) Kopperamanna Bore at 2,970 ft.

Microspores—

Ceratosporites equalis
Cirratriradites spinulosus
Dictyotosporites speciosus
Dictyotosporites complex
Ischyosporites scaberis
Ischyosporites punctatus
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Lycopodiumsporites circolumenus
Lycospora mollis
Neoraistrickia truncatus
Osmundacidites comaumensis
Radiatisporites hughesi

(d) Cootabarlow Bore No. 2 at 1,465 ft.

Microspores—

Ceratosporites equalis
Dictyotosporites speciosus
Dictyotosporites complex
Ischyosporites punctatus
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Lycopodiumsporites circolumenus
Neoraistrickia truncatus
Osmundacidites comaumensis
Radiatisporites hughesi

Megaspores—

Minerisporites marginatus

2. Victoria

(a) Apollo Bay

Microspores—

Apiculatisporis wonthaggiensis
Ceratosporites equalis
Cicatricosisporites australiensis
Cirratriradites spinulosus
Dictyotosporites speciosus
Ischyosporites scaberis
Leptolepidites verrucatus
Lycospora mollis
Neoraistrickia truncatus
Osmundacidites comaumensis
Pilosisporites notensis

(b) San Remo

Microspores—

Ceratosporites equalis
Ischyosporites scaberis
Leptolepidites verrucatus
Lycopodiumsporites circolumenus
Neoraistrickia truncatus
Osmundacidites comaumensis

(c) Cape Paterson

Microspores—

Ceratosporites equalis
Cicatricosiporites australiensis
Cirratriradites spinulosus
Dictyotosporites speciosus
Granulatisporites dailyi
Ischyosporites scaberis
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Neoraistrickia truncatus
Osmundacidites comaumensis
Pilosisporites notensis
Radiatisporites hughesi

(d) Wonthaggi State Coal Mine Area, localities (a), (b), (c^3), (e^2)

Microspores—

Apiculatisporis wonthaggiensis localities (c^3), (e^2) only
Ceratosporites equalis
Cicatricosisporites australiensis
Cirratriradites spinulosus localities (a), (b), (e^2) only
Dictyotosporites speciosus
Dictyotosporites complex
Granulatisporites dailyi
Ischyosporites punctatus locality (b) only
Ischyosporites scaberis
Kuylisporites lunaris localities (b), (e^2) only
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Lycopodiumsporites circolumenus localities (a), (b) only
Lycospora mollis locality (b) only
Neoraistrickia truncatus
Osmundacidites comaumensis
Pilosisporites notensis
Radiatisporites hughesi localities (a), (b), (c^3) only
Styxisporites lincaris localities (a), (b), (e^2) only

Megaspores—

Mincrisporites marginatus, localities (b), (e^2) only

(e) Whitelaw Railway Station

Microspores—

Apiculatisporis wonthaggiensis
Ceratosporites equalis
Cicatricosisporites australiensis
Dictyotosporites speciosus
Granulatisporites dailyi
Ischyosporites scabcris
Leptolepidites verrucatus
Lycopodiumsporites austraclavatidites
Lycopodiumsporites circolumenus
Neoraistrickia truncatus
Osmundacidites comaumensis
Radiatisporites hughesi

(f) Berry Creek Bore at 278 ft., Bore 7, sample 18

Microspores—

Ceratosporites equalis
Cicatricosisporites australiensis
Cirratriradites spinulosus
Ischyosporites scaberis
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Lycopodiumsporites circolumenus
Neoraistrickia truncatus
Osmundacidites comaumensis
Pilosisporites notensis
Radiatisporites hughesi

(g) Tyers Bore No. 2 at 860 ft.

Microspores—

Ceratosporites equalis
Cicatricosisporites australiensis
Cirratriradites spinulosus
Dictyotosporites speciosus
Granulatisporites dailyi
Ischyosporites scabcris
Kuylisporites lunaris
Leptolepidites verrucatus
Neoraistrickia truncatus
Osmundacidites comaumensis

(h) Korumburra, shale above coal

Microspores—

Apiculatisporites wonthaggiensis
Ceratosporites equalis
Cicatricosisporites australiensis
Dictyotosporites speciosus
Granulatisporites dailyi
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Osmundacidites comaumensis
Pilosisporites notensis
Radiatisporites hughesi

B. Lower Cretaceous (Aptian and Albian)

1. South Australia

(a) Robe Bore

(i) 3,500 ft.

Microspores—

Ceratosporites equalis
Cicatricosporites australiensis
Cingulatisporites euskirchensoides
Ischyosporites scaberis
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Neoraistrickia truncatus
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis

(ii) 3,325 ft.

Microspores—

Apiculatisporis asymmetricus
Ceratosporites equalis
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cirratriradites spinulosus
Ischyosporites scaberis
Leptolepidites verrucatus
Neoraistrickia truncatus
Perotrilites striatus

Megaspores—

Minerisporites marginatus

(iii) 2,630 ft.

Microspores—

Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cingulatisporites simplex
Cirratriradites spinulosus
Ischyosporites scaberis
Lycopodiumsporites austroclavatidites
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis

Megaspores—

Balmeisporites holodictyus

(iv) 2,325 ft.

Microspores—

Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cirratriradites spinulosus
Cirratriradites verrucosus
Lycopodiumsporites austroclavatidites
Osmundacidites australiensis
Perotrilites striatus
Pilosisporites notensis

(v) 1,780 ft.

Microspores—

Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cirratriradites spinulosus
Cirratriradites verrucosus
Lycopodiumsporites austroclavatidites
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis
Trilobosporites trioreticulosus

Megaspores—

Balmeisporites holodictyus
Minerisporites marginatus

(vi) 1,400 ft.

Microspores—

Apiculatisporis asymmetricus
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cingulatisporites simplex
Cirratriradites spinulosus
Cirratriradites verrucosus
Cirratriradites tilchaensis
Divisisporites euskirchenensis
Perotrilites striatus
Pilosisporites notensis
Styxisporites majus
Trilobosporites trioreticulosus

Megaspores—

Pyrobolospora hexapartita
Pyrobolospora reticulata
Pyrobolospora nuda
Balmeisporites holodictyus
Balmeisporites tridictyus
Minerisporites marginatus

(b) Tilcha Bore No. 1, 460-1,040 ft.

Microspores—

Apiculatisporis asymmetricus
460 ft.
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
1,040 ft.
Cingulatisporites paradoxus
Cingulatisporites simplex
1,040 ft.
Cirratriradites spinulosus
460 ft.
Cirratriradites tilchaensis
460 ft.
Divisisporites euskirchenensis
460 ft.
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis
Styxisporites majus
Trilobosporites trioreticulosus

Megaspores—

Balmeisporites holodictyus
Balmeisporites tridictyus
Pyrobolospora hexapartita
460 ft.
Pyrobolospora nuda
460 ft.
Pyrobolospora reticulata
1,040 ft.

(c) Cootabarlow Bore No. 2

(i) 1,354 ft.

Microspores—

Ceratosporites equalis
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Dictyotosporites speciosus
Ischyosporites punctatus
Leptolepidites verrucatus
Lycopodiumsporites circolumenus
Lycopodiumsporites austroclavatidites
Neoraistrickia truncatus
Osmundacidites comaumensis
Pilosisporites notensis

(ii) 581 ft.

Microspores—

Apiculatisporis asymmetricus
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cirratriradites spinulosus
Cirratriradites verrucosus
Perotrilites striatus
Pilosisporites notensis
Styxisporites majus
Trilobosporites trioreticulosus

Megaspores—

Balmeisporites holodictyus
Pyrobolospora reticulata

(d) Loxton Bore, 1,410-70 ft.

Microspores—

Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cirratriradites spinulosus
Ischyosporites punctatus
1,410 ft.
Ischyosporites scaberis
Leptolepidites verrucatus
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis

Megaspores—

Balmeisporites holodictyus
1,410 ft.
Minerisporites marginatus
1,410 ft.
Pyrobolospora reticulata
1,410 ft.

(e) Comaum Bore at 708 ft.

Microspores—

Ceratosporites equalis
Cicatricosisporites australiensis
Cirratriradites spinulosus
Dictyotosporites speciosus
Ischyosporites scaberis
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Neoraistrickia truncatus
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis
Radiatisporites hughesi

Megaspores—

Minerisporites marginatus

2. Victoria

(a) Dergholm Bore No. 1 at 532 ft.

Microspores—

Apiculatisporis asymmetricus
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cingulatisporites simplex
Cirratriradites spinulosus
Cirratriradites verrucosus
Ischyosporites scaberis
Leptolepidites verrucatus
Osmundacidites comaumensis
Perotrilites striatus

Megaspores—

Pyrobolospora reticulata

(b) Dergholm Bore No. 2 at 329 ft.

Microspores—

Apiculatisporis asymmetricus
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cirratriradites spinulosus
Leptolepidites verrucatus
Perotrilites striatus

Megaspores—

Minerisporites marginatus
Pyrobolospora reticulata

(c) Gellibrand River (Devil's Kitchen)

Microspores—

Apiculatisporis asymmetricus
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cirratriradites spinulosus
Perotrilites striatus
Trilobosporites trioreticulosus

(d) Birregurra Bore No. 1, 1,102-1079 ft.

Microspores—

Apiculatisporis asymmetricus 1,102-1,089 ft.
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides 1,089-1,102 ft.
Cingulatisporites paradoxus
Cingulatisporites simplex 1,102-1,089 ft.
Cirratriradites spinulosus 1,102-1,089 ft.
Divisisporites euskirchenensis 1,102 ft.
Leptolepidites verrucatus 1,102 ft.
Lycopodiumsporites austroclavatidites 1,102-1,089 ft.
Lycospora mollis 1,102-1,089 ft.
Osmundacidites comaumensis
Perotrilites striatus
Styxisporites majus
Trilobosporites trioreticulosus

Megaspores—

Balmeisporites holodictyus 1,102-1,089 ft.

(e) Barongarook Creek

Microspores—

Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cingulatisporites simplex
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis
Trilobosporites trioreticulosus

Megaspores—

Balmeisporites holodictyus
Minerisporites marginatus

(f) Barrabool Hills

Microspores—

Cicatricosisporites australiensis
Cingulatisporites paradoxus
Granulatisporites dailyi
Ischyosporites scaberis
Kuylisporites lunaris
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Lycospora mollis
Neoraistrickia truncatus
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis
Trilobosporites trioreticulosus

Megaspores—

Balmeisporites holodictyus

(g) Little's Shaft, Bellarine Peninsula

Microspores—

Apiculatisporis asymmetricus
Ceratosporites equalis
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cingulatisporites simplex
Cirratriradites spinulosus
Kuylisporites lunaris
Leptolepidites verrucatus
Lycopodiumsporites austroclavatidites
Lycopodiumsporites circolumenus
Neoraistrickia truncatus
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis
Styxisporites majus
Trilobosporites trioreticulosus

Megaspores—

Balmeisporites holodictyus
Pyrobolospora reticulata

(h) Woodside Well No. 2 at 4,251 ft. and 6,402 ft.

Microspores—

Apiculatisporis asymmetricus
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus 4,251 ft.
Cirratriradites spinulosus
Divisisporites euskirchenensis 4,251 ft.
Ischyosporites scaberis
Leptolepidites verrucatus
Lycopodiumsporites circolumenus 6,402 ft.
Lycospora mollis 4,251 ft.
Osmundacidites comaumensis
Perotrilites striatus 6,402 ft.
Pilosisporites notensis 4,251 ft.

3. New South Wales

Onepah Station Well

Microspores—

Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
Cingulatisporites paradoxus
Cirratriradites spinulosus
Cirratriradites verrucosus
Cirratriradites tilchaensis
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis
Styxisporites majus
Trilobosporites trioreticulosus

Megaspores—

Balmeisporites holodictyus
Minerisporites marginatus
Pyrobolospora hexapartita
Pyrobolospora reticulata

4. Queensland

Styx Coal Measures, Bore 21 at 327 ft., Bore 20 at 454 ft.

Microspores—

Ceratosporites equalis
327 ft.
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
454 ft.
Cirratriradites spinulosus
Cirratriradites verrucosus
Cirratriradites tilchaensis
327 ft.
Ischyosporites scaberis
454 ft.
Leptolepidites verrucatus
327 ft.
Osmundacidites comaumensis
Perotrilites striatus
Pilosisporites notensis
Styxisporites majus
Trilobosporites trioreticulosus

Megaspores—

Balmeisporites holodictyus

5. Papua

Omati Bore, samples 1 and 2

Microspores—

Apiculatisporis asymmetricus (2)
Cicatricosisporites australiensis
Cingulatisporites euskirchensoides
(2)
Leptolepidites verrucatus
Perotrilites striatus

Megaspores—

Balmeisporites holodictyus

Stratigraphical Implications

The samples from which the spores recorded above were recovered were portions of bore cores and outcrops of both fresh- and salt-water origin. The age of the salt-water deposits is known by the contained foraminifera, mollusca, and microplankton to be Lower Cretaceous; the freshwater sediments have been referred to the Jurassic on the basis of their macroscopic plant remains.

Although only a small proportion of the spores contained in both kinds of sediments have been considered in this contribution, it has been found that some of them are restricted to particular deposits while others are common to most, if not, all of them. Thus it seems possible to distinguish between "long" and "short-range" species and by means of the latter, to correlate the dated salt-water samples with the less reliably dated freshwater deposits, and to correlate individual freshwater deposits with one another.

The only continuous sequence avalable for study, has been the conformable succession of freshwater sediments intersected by the Robe Bore, 1,400-4,300 ft. In this section, a marked change in spore composition is noticeable above 3,500 ft., the sediments below this depth containing a different assemblage from that at or above it. It seems probable therefore that this change was coincident with a change in age which resulted in the passing out of older types and the incoming of newer ones in the vicinity of this level.

The Lower Cretaceous salt-water deposits comprise those from the Cootabarlow Bore at 581 ft. and 1,354 ft., the Tilcha Bore at 460 ft. and 1,040 ft., the Loxton Bore at 1,410 ft. and 1,470 ft., the Tooloombah Creek Bore No. 21 at 327 ft., and the Onepah Station Well. All these deposits are of Albian age, with the exception of the one at 1,354 ft. from the Cootabarlow Bore which is Aptian on the basis of foraminifera (N. H. Ludbrook, South Australian Department of Mines) and microplankton (Cookson and Eisenack 1958).

The short-range spores which occur in the Albian deposits are: *Divisisporites euskirchenensis, Cingulatisporites euskirchensoides* (Wealden in Belgium), *Cingulatisporites paradoxus, Cingulatisporites simplex, Trilobosporites trioreticulosus, Apiculatisporis asymmetricus, Perotrilites striatus, Pyrobolospora reticulata, Balmeisporites holodictyus.* A comparable association (Fig. 1) has been found in the upper section of the Robe Bore, 1,400-3,500 ft.; Dergholm Bore No. 1, at 532 ft. and 582 ft., Dergholm Bore No. 2, 329-31 ft.; Barongarook Creek; Birregurra Bore No. 1, 1,079-1,102 ft.; Gellibrand River (Devil's Kitchen); Barrabool Hills; Little's Shaft, Bellarine Peninsula, and Woodside Well No. 2, 4,257-6,402 ft. It appears therefore that the age of these deposits is Lower Cretaceous (approximately Albian) and not Lower Jurassic as was suggested for some of them by Medwell (1954a).

The spore association taken as typifying the lower portion of the Robe sequence represented by the samples taken at 3,860 ft. and 4,300 ft. comprises species such as *Granulatisporites dailyi, Apiculatisporis wonthaggiensis, Radiatisporites hughesi, Dictyotosporites speciosus, Dictyotosporites complex* and *Styxisporites majus,* none of which appear to be present in the Albian sediments. This difference in composition suggests that the age of the lower portion is almost certainly pre-Albian.

The number of spore types common to both the Albian and pre-Albian sediments of the Robe Bore for example, *Pilosisporites notensis, Ceratosporites equalis, Neoraistrickia truncatus, Lycospora mollis, Cirratriradites spinulosus, Cirratriradites verrucosus,* indicates that the older sediments approximate more closely to a Lower Cretaceous (pre-Albian) age than to the Jurassic age suggested for them by Ward (1917).

A comparable spore association to that found in the pre-Albian section of the Robe Bore occurs in deposits from the Wonthaggi State Coal Mine Area, and some of the same types occur in the deposit from the Kopperamanna Bore at 2,970 ft., and Cootabarlow Bore No. 2 at 1,465 ft., along with others that appear to be absent from the Robe sediments. The general agreement between these respective spore associations suggests that all are of approximately the same age, and that the Wonthaggi deposits are probably Lower Cretaceous (pre-Albian) rather than Lower-Middle Jurassic as suggested by Seward (1904) or Lower Jurassic as suggested by Medwell (1954a). Additional evidence for this younger age is provided by the occurrence of the megaspore *Minerisporites marginatus,* a type which occurs in the Wealden of the Netherlands Dijkstra (1951), and in England in the Ashdown Sands of the Wealden formation (Valanginian, Hughes 1958, p. 43).

When Seward compared the macroflora of the Wonthaggi Area with that of the Inferior Oolite of England and Rajmahal Hills of India, the age of the latter was considered to be Lower Jurassic. However, as the result of Dr. Spath's discovery of Neocomian ammonites in the Rajmahal Formation, a Lower Cretaceous (Neocomian) age has now been suggested for this formation (Arkell 1956).

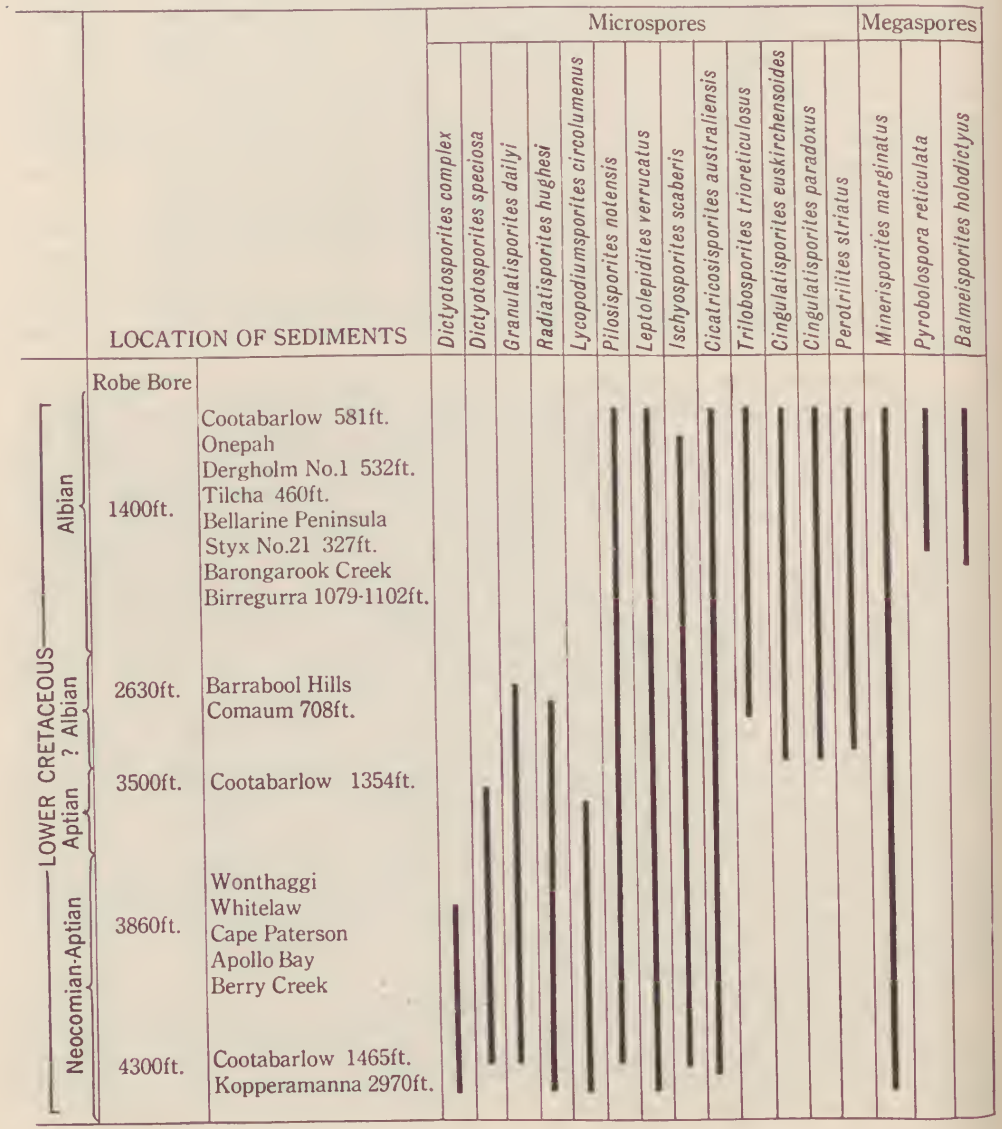
A similar age for the sediments from bores and outcrops at Wonthaggi, Cape Paterson, Berry Creek and Tyers River would conform with the spore content as as present known. Mr. B. E. Balme, who has investigated the Upper Mesozoic of Western Australia, has remarked upon the greater resemblance of the Wonthaggi microflora to that of the West Australian Lower Cretaceous than to the microfloras of the Upper Jurassic of the same area.

The South Australian deposits in the Cootabarlow No. 2 Bore at 1,465 ft. and in the Kopperamanna Bore at 2,970 ft., contain microflora assemblages comparable with those found in the Robe Bore, 4,300-3,860 ft., and in the Wonthaggi coals and associated shales. The sandstones, 3,000-2,810 ft., in the Kopperamanna Bore which undelie marine Cretaceous sediments were assigned by Whittle and Chebotarev

(1952, Fig. 2) to the Jurassic. More recently Woodard (1955, p. 15) suggested that "Interbedded coarse sandstones and subordinate clay shales underlying lower Cretaceous marine beds and regarded by Whittle (1952) as Jurassic, more probably represent the basal Cretaceous Blythesdale Sandstones".

There is thus some evidence for a Lower Cretaceous (pre-Albian) age for the Mesozoic deposits in the Wonthaggi State Coal Mine Area of Victoria and the lower sediments of the Robe Bore, 3,860-4,300 ft. These beds are tentatively referred to

TABLE 1



the Lower Cretaceous (Neocomian-Aptian). However, the possibility of an age older than Lower Cretaaceous, but younger than Lower Jurassic, must not be overlooked.

The sediments in the Comaum Bore, 651-708 ft., are of interest in containing a spore assemblage "intermediate" between typical Albian and Neocomian-Aptian microfloras. The presence of the microspore *Perotrilites striatus*, a species that has been invariably present in all the Albian deposits examined, leaves no doubt as to the Lower Cretaceous age of these deposits.

The spore assemblage of the Aptian deposit at 1,354 ft. in the Cootabarlow Bore No. 2, is closely similar to that of typical Albian deposits, but neither the microspore *Perotrilites striatus* nor the megaspores *Pyrobolospora reticulata*, and *Balmeisporites holodictyus* have been observed in it.

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Explanation of Plates

All the figures are from untouched negatives. Registered numbers in the palaeobotanical collection of the National Museum of Victoria are given.

PLATE XIV

Fig. 1.—*Divisisporites euskirchenensis* Thomson. Robe Bore, S.A., at 1,400 ft. × *c.* 580.

Figs. 2, 3.—*Granulatisporites dailyi* sp. nov. Proximal and distal surfaces of holotype. Wonthaggi State Coal Mine Area, Vic., locality (c^3). × *c.* 590. P17605.

Fig. 4.—*Granulatisporites dailyi.* Paratype. Comaum Bore, S.A., at 708 ft. × *c.* 560.

Fig. 5.—*Leptolepidites verrucatus* Couper. Wonthaggi State Coal Mine Area, Vic., locality (b). × *c.* 650.

Fig. 6.—*Leptolepidites verrucatus.* Apollo Bay, Vic. × *c.* 650.

Figs. 7, 9, 10.—*Apiculatisporis wonthaggiensis* sp. nov. Paratypes. Wonthaggi State Coal Mine Area, Vic., locality (c^3). Fig. 7, × *c.* 840; Fig. 9, × *c.* 570; Fig. 10, × *c.* 620.

Fig. 8.—*Apiculatisporis wonthaggiensis.* Holotype. Wonthaggi State Coal Mine Area, Vic., locality (c^3). × *c.* 610. P17606.

Fig. 11.—*Apiculatisporis asymmetricus* sp. nov. Holotype. Birregurra Bore No. 1, Vic. at 1,102 ft. × *c.* 590. P17607.

Fig. 12.—*Apiculatisporis asymmetricus.* Paratype. Dergholm Bore No. 1, Vic. at 532 ft. × *c.* 590.

Fig. 13.—*Osmundacidites comaumensus* (Cookson). Holotype. Comaum Bore, S.A. at 674 ft. × *c.* 550. P17608.

Fig. 14.—*Neoraistrickia truncatus* (Cookson). Holotype. Comaum Bore, S.A. at 708 ft. × *c* 600.

Fig. 15.—*Neoraistrickia truncatus.* Paratype. Comaum Bore, S.A. at 708 ft. × *c.* 620.

Fig. 16.—*Neoraistrickia truncatus.* Showing the small processes of the proximal surface. Wonthaggi State Coal Mine Area, Vic., locality (b). × *c.* 870.

Figs. 17-19.—*Ceratosporites equalis* sp. nov. Proximal, sectional and distal views of holotype. Wonthaggi State Coal Mine Area, Vic., locality (b). × *c.* 640. P17609.

Fig. 20.—*Ceratosporites equalis*. Lateral view. Wonthaggi State Coal Mine Area, Vic., locality (b). × *c.* 580.

Fig. 21.—*Kuylisporites lunaris*. Paratype. Wonthaggi State Coal Mine Area, Vic., locality (e^2). × *c.* 550.

Figs. 22, 23.—*Kuylisporites lunaris* sp. nov. Holotype. Wonthaggi State Coal Mine Area, Vic., locality (e^2). Fig. 22, × *c.* 650; Fig. 23, × *c.* 850. P17610.

Plate XV

Fig. 1.—*Pilosisporites notensis* sp. nov. Holotype. Robe Bore, S.A. at 3,680 ft. × *c.* 570. P17611.

Fig. 2.—*Pilosisporites notensis*. Paratype. Robe Bore, S.A. at 3,860 ft. × *c.* 570.

Fig. 3.—*Pilosisporites notensis* in equatorial view. Robe Bore, S.A. at 3,860 ft. × *c.* 570.

Figs. 4, 5.—*Radiatisporites hughesi* sp. nov. Wonthaggi State Coal Mine Area, Vic., locality (c^3). Fig. 4, Holotype, × *c.* 580, P17612; Fig. 5, Paratype, × *c.* 700.

Fig. 6.—*Radiatisporites hughesi*. Distal surface of a paratype. Wonthaggi State Coal Mine Area, Vic., locality (b). × *c.* 580.

Fig. 7.—*Ischyosporites scaberis* sp. nov. Paratype in sub-polar view. Robe Bore at 3,860 ft. × *c.* 570.

Figs. 8, 9.—*Ischyosporites scaberis*. Proximal and distal surfaces of holotype. Robe Bore at 3,860 ft. × *c.* 570. P17613.

Figs. 10, 11.—*Lycopodiumsporites circolumenus* sp. nov. Proximal and distal surfaces of holotype. Wonthaggi State Coal Mine Area, Vic., locality (b). × *c.* 560. P17614.

Fig. 12.—*Lycopodiumsporites austroclavatidites* (Cookson). Holotype. Comaum Bore, S.A. at 674 ft. × *c.* 560. P17615.

Fig. 13.—*Cicatricosisporites australiensis* (Cookson). Holotype. Comaum Bore, S.A. at 674 ft. × *c.* 580. P17616.

Fig. 14.—*Cicatricosisporites australiensis*. Berry Creek, Vic., Bore No. 18 at 278 ft. × *c.* 640.

Plate XVI

Figs. 1, 4.—*Ischyosporites punctatus* sp. nov. Kopperamanna Bore, S.A. at 2,970 ft. Fig. 1, proximal surface of holotype. × *c.* 620. P17617; Fig. 4, proximal surface of a paratype in oblique view. × *c.* 600.

Fig. 2.—*Ischyosporites punctatus*. Paratype. Cootabarlow Bore No. 2, S.A. at 1,354 ft. × *c.* 600.

Fig. 3.—*Ischyosporites punctatus*. Loxton Bore, S.A. at 1,410 ft. × *c.* 600.

Fig. 5.—*Dictyotosporites speciosus* sp. nov. Holotype. Wonthaggi State Coal Mine Area, Vic., locality (e^2). × *c.* 850. P17618.

Fig. 6.—*Dictyotosporites speciosus*. Paratype. Robe Bore, S.A. at 3,860 ft. × *c.* 600.

Fig. 7.—*Dictyotosporites speciosus*. High focus of distal surface showing double reticulum. Robe Bore, S.A. at 3,860 ft. × *c.* 1,300.

Figs. 8, 9, 10.—*Dictyotosporites speciosus*. Optical sections of exine of examples from the Robe Bore, S.A. × *c.* 1,300.

Fig. 11.—*Dictyotosporites complex* sp. nov. Holotype. Robe Bore, S.A. at 3,870 ft. × *c.* 610. P17619.

Figs. 12, 13.—*Dictyotosporites* cf. *complex*. Robe Bore, S.A. Fig. 12, × *c.* 600; Fig. 13, a more highly magnified surface view of the specimen in fig. 12, showing the reticulum and the supporting threads which are represented by small white or black "dots" at the angles of the mesh. × *c.* 1,300.

Fig. 14.—*Dictyotosporites* cf. *complex*. Wonthaggi State Coal Mine Area, locality (b). × *c.* 600.

Figs. 15, 16.—*Dictyotosporites complex*. Kopperamanna Bore, S.A. Fig. 15, exine after removal of outer reticulum showing thread-like "primary" processes. × *c.* 1,300; Fig. 16, one of of the "primary" processes showing bifurcation. × *c.* 1,800.

Fig. 17.—*Pcrotrilites striatus* Cookson and Dettmann. Robe Bore, S.A. × *c.* 630.

Fig. 18.—*Pcrotrilites striatus*. Styx Coal Measures Qsld., Bore No. 21 at 327 ft. × *c.* 600.

Plate XVII

Figs. 1, 2.—*Trilobosporites triorcticulosus* sp. nov. Paratypes. Cootabarlow No. 2 Bore, S.A. at 581 ft. Fig. 1, × *c.* 590; Fig. 2, × *c.* 530.

Fig. 3.—*Trilobosporites triorcticulosus*. Holotype. Styx Coal Measures, Qsld., Bore No. 21 at 327 ft. × *c.* 590. P17620.

Figs. 4-6.—*Cingulatisporites cuskirchensoides* Delcourt and Sprumont. Fig. 4, Birregurra Bore No. 1, Vic. at 1,102 ft. × *c.* 640; Fig. 5, Robe Bore, S.A. at 2,630 ft. × *c.* 540; Fig. 6, Styx Coal Measures Bore No. 21, Qsld. at 327 ft. × *c.* 540.

Fig. 7.—*Cingulatisporites simplex* sp. nov. Paratype. Birregurra Bore No. 1, Vic., 1,089-90 ft. × *c.* 540.

Fig. 8.—*Cingulatisporites simplex*. Holotype. Birregurra Bore No. 1, Vic. at 1,102 ft. × *c.* 600. P17621.

Figs. 9, 11.—*Cingulatisporites paradoxus* sp. nov. Paratypes. Birregurra Bore No. 1, Vic. 1,089-90 ft. × *c.* 600; Fig. 9, showing faint indications of tetrad-scar.

Fig. 10.—*Cingulatisporites paradoxus*. Holotype. Birregurra Bore No. 1, Vic. 1,089-90 ft. × *c.* 600. P17622.

Figs. 12, 13.—*Cingulatisporites paradoxus*. Paratypes. Robe Bore, S.A. at 2,630 ft. × *c.* 570; Fig. 12, showing fovea.

Fig. 14.—*Lycospora mollis* sp. nov. Holotype. Birregurra Bore No. 1, Vic., 1,089-90 ft. × *c.* 600. P17623.

Figs. 15-17.—*Lycospora mollis*. Paratypes. Barrabool Hills, Vic. Fig. 15, spore in oblique view. × *c.* 600; Figs. 16, 17, high and low focus of spore in equatorial view. × c. 400.

Plate XVIII

Fig. 1.—*Dictyotosporites complex*. Cootabarlow Bore No. 2, S.A. at 1,465 ft. × *c.* 590.

Figs. 2, 3.—*Cirratriradites verrucosus* sp. nov. Polar views of proximal and distal surfaces of a paratype. Tilcha Bore, S.A. at 1,040 ft. × *c.* 560.

Fig. 4.—*Cirratriradites verrucosus*. A paratype with large distal fovea. Weipa Bore No. 1, North Qsld. at 2,022 ft. × *c.* 560.

Figs. 5, 6.—*Cirratriradites verrucosus*. Holotype in proximal and distal views. × *c.* 560. P17624.

Fig. 7.—*Cirratriradites tilchaensis* sp. nov. Distal view of holotype. Tilcha Bore, S.A. at 460 ft. × *c.* 560. P17625.

Fig. 8.—*Cirratriradites tilchaensis*. Distal view of a paratype. Tilcha Bore, S.A. at 1,040 ft. × *c.* 560.

Fig. 9.—*Cirratriradites spinulosus sp. nov.* Optical section of holotype. Wonthaggi State Coal Mine Area, Vic., locality (e^2). × *c.* 590. P17632.

Figs. 10, 13.—*Cirratriradites spinulosus*. Fig. 10, distal surface of spore from Gellibrand River, Vic. (Devil's Kitchen), × *c.* 570; Fig. 13, Robe Bore, S.A. at 3,325 ft. × *c.* 580.

Figs. 11, 12.—*Cirratriradites spinulosus*. Proximal and distal surfaces of a paratype. Onepah Station Well, N.S.W. × *c.* 570.

Plate XIX

Figs. 1, 2.—*Cirratriradites spinulosus*. Gellibrand River (Devil's Kitchen), Vic. Fig. 1, distal surface, × *c.* 560; Fig. 2, exine of proximal polar area showing variability in size and shape of spinule-bases, × *c.* 560, exceptionally large.

Fig. 3.—*Cirratriradites spinulosus*. Showing much enlarged spinule-bases, Apollo Bay, Vic. × *c.* 570.

Figs. 4, 5.—*Cirratriradites spinulosus*. Fig. 4, Tyers Bore No. 2, Vic. at 860 ft. × *c.* 570; Fig. 5, Cootabarlow Bore No. 2, S.A. at 581 ft. × *c.* 560.

Figs. 6, 7.—*Styxisporites linearis* sp. nov. Distal view and optical section of holotype. Wonthaggi State Coal Mine Area, locality (e^2). × *c.* 570. P17630.

Figs. 8, 9.—*Styxisporites linearis*. Proximal and distal surface of a paratype. Wonthaggi State Coal Mine Area, Vic., locality (b). × *c.* 600.

Fig. 10.—*Styxisporites majus* sp. nov. Distal surface of holotype. Tilcha Bore, S.A. at 460 ft. × *c.* 580. P17625.

Figs. 11, 12.—*Styxisporites majus*. Paratypes. Styx Coal Measures, Qsld., Bore No. 21 at 327 ft. × *c.* 560.

Figs. 13, 14.—*Styxisporites majus*. Fig. 13, examples showing short and stumpy as well as pointed projections from Moora Bore, W.A., 86-170 ft. × *c.* 560; Fig. 14, example with ornament in the form of short and slender spinules. Bellarine Peninsula, Little's Shaft No. 2, 38-47 ft. × *c.* 560.